# “MENSTRUAL DISTRESS AMONG ATHLETES AND NON-ATHLETES – A COMPARATIVE STUDY”

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By

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# CERTIFICATE

I hereby certify that the dissertation entitled **"Menstrual Distress among Athletes and Non-Athletes – A Comparative study"** prepared and submitted by Ms. Ashwitha Susan Elias is an original research work carried out under my guidance and supervision.

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# DECLARATION

I hereby declare that this research work entitled **"Menstrual Distress among Athletes and Non- Athletes – A Comparative study"** is an original research work carried out by me under the supervision and guidance of Dr. Rashmi H Poojara, Assistant Professor, Department of Home Science, St. Teresa's College Ernakulam.

**Place:** **Ashwitha Susan Elias**

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# INTRODUCTION

# CHAPTER 1

# INTRODUCTION

The nutritional needs of women are clearly different from those of men, highlighting the need to investigate the nutritional effects of exercise in women (Hinton *et al*., 2004 and Gabel, 2000). This is mainly because women are more prone to food shortages due to the continuous cycle that occurs in their bodies (Manore, 2002). It follows that female athletes have completely different nutritional needs than their non-athletic counterparts (Haymes *et al.,* 2006). Women who exercise regularly have higher requirements for certain nutrients, and it is very important to maintain adequate nutritional levels to avoid eating disorders (Chris *et al*., 2010 and Malczewska *et al*., 2000). The most important nutritional factors in women's sports nutrition would be the need for iron and calcium to help the body achieve maximum performance. Evidence shows that female athletes have nutritional problems, especially with regard to energy, fat, iron and calcium intake, Miller (2003) and Constantini *et al.* (2000) report. Inadequate nutrient intake is a major nutritional problem for today's athletes. Because these athletes do not expend enough energy to complete their training, they are at risk for eating disorders, menopause and osteoporosis, collectively known as the female athlete triad (Gabel, 2006 and Nattiv *et al*., 2007).

Anemia is a global problem, prevalent in both developing and developed countries, with a much lower prevalence in the latter than in the former (WHO, 2006). South Asian countries, including India, are the world's most common iron deficiency anemia region (Rajagopalan, 2009). In India, more than 320 million people suffer from iron deficiency anemia (IDA). The prevalence of IDA is 60-70 percent among children, 50 percent among teenage girls, and 40-80 percent among women (NNMB, 2008). The current Five Year Plan (Eleventh Plan) aims to reduce the prevalence of anemia in women and girls by 50 percent by the end of the plan period (Planning Commission, 2007). The United Nations reiterated that the control of nutritional anemia should be one of the global development goals to be achieved in the early years of this new millennium (Krause *et al*., 2004). The main cause of this serious micronutrient malnutrition is inadequate eating (Gopalan, 2008).

Anemia was considered the most common disease in athletes, especially among female athletes (Antonio *et al*., 2001). Anemia is said to occur when the hemoglobin concentration falls below the level defined as normal for a person's age and sex. Due to the high prevalence of iron deficiency anemia in developing countries, it has greater importance as a factor limiting physical work capacity (PWC) because hemoglobin is involved in oxygen transport (Boyadjiev *et al.,* 2000). Anemia is a major problem in female athletes, and possible causes of sports anemia include increased plasma volume, decreased hemoglobin synthesis, and increased destruction of erythrocytes (Benardot, 2006). A diet low in iron can make this condition worse. Athletes can also experience iron depletion and increased iron loss through urine, sweat, internal bleeding, injuries, etc. (Volpe, 2006). Another source of blood loss in female athletes is menstruation, which leads to physiological iron loss (Hallberg *et al*., 1991). If the body does not get the right amount of iron, it becomes a main factor in reducing performance in sports. More than 50% of female endurance athletes are iron depleted, suggesting that diet may be necessary to prevent anemia (Florentino, 2003).

Studies have shown that up to 45 percent of high school runners have low iron stores (Malczewska *et al.,* 2000). The NFHS-3 survey also highlighted the presence of widespread anemia throughout the life cycle, with 79 percent of children and 56 percent of women of childbearing age suffering from anemia. One of the effects of anemia is reduced work performance because reduced hemoglobin (Hb) levels reduce the blood's ability to carry oxygen to move muscles (Dubnov and Constantini, 2004). Symptoms of iron deficiency anemia include burning muscles, shortness of breath during exercise, nausea, frequent infections, respiratory problems, and a pale complexion (Beard and Tobin, 2000).

The term “sports anemia” is commonly used to describe iron deficiency and the resulting drop in hemoglobin to anemic levels. Sports anemia occurs in athletes who dramatically increase their exercise intensity (Magnusson *et al.,* 1984). Red blood cell counts and hemoglobin concentrations have been shown to be lower in athletes than in sedentary people (Boyadjiev and Taralov, 2001), suggesting that physical activity requires more iron and that intake exceeds it. may support the hypothesis that Athletes may be at risk for iron deficiency due to sweating, bowel movements, increased systemic hemoglobin demand, loss of menstruation in women, and poor nutritional intake (ADA, 2003).

Sports anemia is a period during which athletes may develop low blood hemoglobin levels early in training, possibly reflecting a normal adaptation to physical training. According to Antonio et al., aerobic exercise increases blood volume, and increased hydration reduces the number of red blood cells per unit of blood. (2001). In athletes, true anemia is present when hemoglobin levels are below 13 g/dl in men and below 12 g/dl in women (Clark, 1999). Athletes who engage in vigorous exercise for long periods of time, such as daily endurance training, may develop some degree of anemia. Possible causes of sports anemia include increased plasma volume, decreased Hb synthesis, and increased destruction of red blood cells. Therefore, chronic iron deficiency due to persistent iron deficiency can adversely affect health, physical and mental performance and requires immediate medical intervention and monitoring (Cowell *et al.,* 2003).

The three basic approaches to prevent iron deficiency anemia are medicinal iron supplementation, dietary modification, iron fortification, and food fortification (Rao, 1993). For iron-deficient athletes, iron supplementation not only improves blood biochemistry and iron status, but also improves work performance as reflected in increased oxygen uptake, decreased heart rate, and decreased lactate concentration during exercise. improvement (Lukaski, 2004). One of the cheapest, safest, and most sustainable forms of dietary intervention is the introduction of iron-rich foods into the diet and its biology to provide a lasting solution to the problem of iron deficiency anemia. to ensure availability (Narasinga Rao, 2003). An obvious approach to combat anemia is therefore to improve the diet through consumption of iron-rich grains, sorghum, legumes and green leafy vegetables.

There is not much information on iron nutrition for athletes in general and female athletes in particular. Especially with more women participating in competitive sports, the need to understand the nutritional profile of female athletes is critical. Now is the time to highlight the potential of sports talent, so building a strong sports team should start with education at the school/college level. There is an urgent need to capture them at this age and understand their health/nutritional status and performance levels. Furthermore, despite the fact that proper nutrition is a year-round challenge, athletes are poorly informed about nutrition and often think about nutrition only during the sports season (Kunkel *et al*., 2001). Dietary interventions combined with nutrition education are a sustainable solution to combat iron deficiency anemia (Maughan and Ronald, 2004).

Untreated sports anemia in female athletes can lead to fatigue, poor performance, weakness, and other complications. As anemia is a common nutritional disorder among women, especially athletes, strategies to sustainably reduce this condition are highly needed. Potential strategies to correct anemia include nutritional supplementation with locally applicable iron-rich food formulations and awareness raising through nutrition education programmes. Dietary supplements can improve nutritional status, hemoglobin levels and, in turn, physical performance. Providing locally available fortified foods has been proven to be cheaper and healthier than giving iron supplements in the form of elemental iron (Power *et al*., 1994). Furthermore, dietary supplements have the dual benefit of not only improving the haematological status but also providing dietary supplements for iron utilization (Bagriansky, 1996). Good sources of animal iron are found in meat, eggs, poultry, liver and fish. Plant sources of iron include fortified grains, sorghum, soy products, fortified rice products, legumes and legumes, and leafy green vegetables, but are less absorbed than animal sources. However, concomitant consumption of foods containing vitamin C can enhance the absorption of iron from plant sources (Keith *et al.,* 2006). Improved iron status leads to increased work capacity and endurance, increased oxygen uptake, decreased heart rate and less muscle fatigue.

Moreover, teaching nutrition can lead to sustainable, healthy eating habits, which alone can help female athletes put into practice the knowledge they have acquired throughout their athletic careers (Jacobson *et al.,* 2001). Nutrition education is a powerful tool to help athletes modify their nutritional intake (Clark *et al*., 1988). Gregorie (1991) pointed out that the athlete's desire for accurate and practical nutritional information increases the challenges and responsibilities of nutritionists, teachers, and coaches. She also points out that more teaching materials need to be developed. However, research focused on developing the most effective methods of educating athletes about sports nutrition is lacking (Jonnalagadda *et al*., 2001). Early onset of fatigue during exercise is a common symptom of athletes, especially female athletes. Overtraining, stress, and many other external factors can cause fatigue, but fatigue is often caused by a lack of iron in the blood, known as anemia, Kimberly and Mueller (2006) says.

A sexually mature female undergoes a set of actions known as menstruation, also referred to as menses, once a month (Muktananda, 2003). A menstrual cycle (MC) is defined as the

period's first day of bleeding through the first day of the subsequent period. Although a cycle typically lasts 28 days, it can last anywhere from 23 to 35 days in a typical cycle. During menstruation, there are pre- and post-ovulatory phases. The three phases of the MC, on the other hand, continue for 28 days and are as follows:

1) the follicular phase, which starts on day one of the cycle and lasts for 10–14 days before ovulation, which is triggered by the hormone follicular stimulating hormone (FSH), which lasts for 22–36 days.

2) Luteal Phase - Eight days following ovulation, on days 18 and 22, PG secretion peaks.

3) The 14-day post-ovulatory phase, which is a defined duration. The pre-ovulatory period can be delayed by an additional 2-3 days as a result of complicated psycho-physiological dysfunctions.

Symptoms of menstrual disorders, called premenstrual syndrome, appear in early puberty. The menstrual process involves the breakdown of the uterine wall, followed by healing effects. This usually interferes with the normal daily functions of the uterus, such as urination. This phase of MC causes severe pain of an organic nature, worsens the disturbance of the mental state, and worse he causes PMS (Premenstrual Syndrome) problems. Epidemiological studies have also shown that approximately 75% of women of childbearing age suffer from some condition associated with the premenstrual phase of the menstrual cycle (Johnson *et al.,* 1988). In fact, PMS is the name given to a group of emotional, mental and physical symptoms that affect women in the days leading up to menstruation. Symptoms include fluid retention, mood swings, depression, weight gain, urinary tract infections, shortness of breath, nasal congestion, headaches, and susceptibility to conjunctivitis. The exact cause of PMS is unknown, but it is believed that: It is related to hormonal imbalance.

Menstrual dysfunction is a widespread issue in the population in the reproductive age group, although menstrual disorders are overlooked in contemporary society. The frequency of menstruation can be affected by a variety of menstrual cycle issues, including polymenorrhoea (frequent periods with intervals of 21 days or less), oligomenorrhoea (infrequent menstrual periods with intervals exceeding 35 days), and amenorrhea (absence of periods for more than 60 days in a woman of reproductive age: physiologically occurs during pregnancy and

breastfeeding). Additionally, psychological issues including stress, worry, and despair are common during the menstrual cycle.

Other conditions that affect menstruation pain include Dysmenorrhea (cramps or painful menstrual cycle, in which a woman experiences menstruation and experiences dull or intermittent and sharp pain, as well as aching pain in the lower abdomen or pelvis), and irregular periods can affect the amount of blood loss. These conditions include Hypomenorrhoea (a reduction in flow or a shortening of the duration of menstruation) and Menorrhagia (an increase in blood loss For the majority of their reproductive lives, women experience pain, anxiety, depression, exhaustion, and vomiting during the menstrual cycle (Sundell *et al*., 1990; Harlow and Park, 1996).

However, research has shown that exercise can assist to relieve dysmenorrhea (Daley, 2008). Endorphins, which the body naturally produces and which are released during aerobic exercise, can help reduce menstruation pain (Bonen and Keizer, 1984; Ganon, 1986). Exercise may also change prostaglandin production. Exercise can also assist some women with additional symptoms like anxiety, mood changes, and sadness. Bloating can be lessened by sweating since it helps the body rid itself of extra water.

### 1.3 Objectives of the study

- To study the prevalence of Menstrual distress and its related symptoms and complications among collegiate Athletes and non-athletes from 3 districts of Kerala.
- To compare the Menstrual distress among Adult Female athletes and non-athletes.
- To assess their nutritional profile through anthropometry, clinical assessment, haemoglobin level and food consumption pattern.
- To obtain insights on their dietary pattern and its quality by computing Healthy Eating Index Scores.

# REVIEW OF LITERATURE

# CHAPTER – 2
# REVIEW OF LITERATURE

The Review of literature pertaining to the study entitled. "Menstrual Distress among Athletes and Non-Athletes – A Comparative study" is presented and discussed under four heads:-



## 2.1 Nutrient intake and athletic performance: An overview

Nutrition is a crucial part of any physical training programme, according to Berning *et al.,* (2000). The fundamental dietary objective for those who are active is to have enough nutrients to improve their health, fitness, or athletic performance. According to *Burus et al.,* (2000), players often consume enough dietary energy to cover all of their vitamin and mineral requirements as well as their daily energy expenditure.According to the Institute of Medicine (2002), protein needs are still ambiguous. Contrary to popular opinion, evidence does not support the idea that eating more protein makes you stronger and improves performance. Protein will be used if there are not enough calories, which is a key factor in the protein sparing action. A typical adult requires 0.8 g/kg bw/d. According to Lemmer (2002), adequate levels of protein and carbs are necessary for the greatest performance.

According to *Wee et al.,* (2005), higher energy metabolism necessitates the consumption of extra B vitamins, which are components of the coenzymes involved in energy cycles. There is no proof that adding B vitamins to a well-nourished athlete can improve

performance. After several years of strictly vegan diet, vegetarian athletes may get vitamin B12 deficiency. Supplements are necessary for these dietary supplements, whether they are single or multivitamin preparations comprising B-complex vitamins, vitamin C, or vitamin E. This is because a well-balanced diet and a normal biochemical vitamin balance do not boost physical performance in athletes.

According to Welsh *et al*., (2002), ACSM, 1997 revealed Ca insufficiency in female cricketers, which is characterized by an insufficient supply of estrogen and disordered diet. Female cricketers who exercise vigorously stop menstruation, suffer from cricketer amenorrhea, and lose bone mass. Increasing calcium and vitamin D consumption through diet changes such as consuming calcium-fortified fruit juices, soy milk and tofu, milk products, sesame seeds, etc. Overexertion causes osteopath energy amenorrhea depletion. Female trifecta of dysfunctional hypothalamic eating: inhibit anorexia nervosa, bulimia, or release of excess cortisol nervosa.

According to Chris (2006), a person's protein requirements for sports nutrition depend on their degree of fitness, work routine, and the amount and type of exercise they do.

According to Fry *et al*., (2010), in order to promote health, the dietary guidelines for fat intake for athletes are similar to or slightly higher than those for non-athletes. Athletes can tolerate slightly higher intakes as long as they maintain their energy balance, replace their intramuscular triacylglycerol reserves, and consume enough necessary fatty acids. Generally speaking, it is advised that athletes consume a reasonable quantity of fat (about 30% of their daily caloric intake), while increases of up to 50% of calories can be consumed safely by athletes during routine, high-intensity exercise.

According to Gunnarsson *et al*., (2013), eating carbohydrates right away after working out accelerates the replenishment of muscle and liver glycogen. However, the recovery of glycogen following stop-go activities seems to take longer. This could be because stop-go activities involve a lot of harmful eccentric contractions of the skeletal muscles. More recent research questions the relationship between eccentric exercise and slower glycogen resynthesis following both a 60-minute football simulation and a 90-minute match. Sportspeople have greater dietary needs than non-athletes. Meeting the energy needs is one of the top nutritional goals for physically active persons because any sport involves significant energy expenditure. Loss of muscular mass, the onset of weariness, recurrent illnesses, and decreased performance are all effects of an energy-deficient diet. Planning

meals appropriately should take into account the amount of exercise and energy expended. To meet energy needs and restore glycogen stores, an intake of 4-6 meals and snacks with 6–10g of carbs per kilogramme bodyweight is advised (NIN, 2007).

## 2.2 Assessment of Nutritional Status and Performance Parameters of Athletes

An individual's nutritional status, which is a measure of their health, has a direct impact on their ability to function physically and at work (ADA, 2005). According to Grand Jean and Ruud (2000), athletes are often seen as the pinnacle of physical health, and as a result, people assume that they have better nutritional status than the general population who are not athletes. Numerous techniques, such as anthropometric, clinical, biochemical, and food intake data, can be used to assess the nutritional status of a group (Duffield, 2000).

### 2.2.1 Anthropometric Measurements

Physical development measured using anthropometry is one of the most helpful factors for determining nutritional status, according to Sharma (2008) and Mathew (1985). Height, weight, mid-arm circumference, chest circumference, and skin fold thickness are all considered standard measurements in nutritional anthropometry (Hui and Yeung 2010; Visweswara Rao *et al*., 1986; and Underwood, 1986).

In a research on Indian athletes, Chandrasekhar and Shanthi (1992) found that they were taller and heavier than the average Indian. According to Ryan and Allan (1974), taller people possess more strength relative to their size. Skin fold thickness measurements, circumference measurements of various body regions, and other anthropometric techniques can all be used to assess body composition in order to determine body fat mass and fat free masses (Van Loan, 1990). According to Micozzi *et al*., (1986), arm circumference is based on uncompressed adipose tissue and indicates both fatness and lean body mass. Age and gender affect the thickness of skin folds (Gorman and Williams, 1991). In his research of Indian athletes, Tripathy (1985) found that gymnasts had the lowest body weight (47.7 kg) while basket ball players had the largest average weight (66.2 kg). The tallest volley ball players (173.2 cm) had the smallest arm circumference (24.9 cm) measurements. Female athletes in the age groups of 13–15, 16–18, and 19–22 years were found to be heavier, taller, and to have larger arm and chest circumferences than non-athletes, according to Devadas *et al*., (1979).

### 2.2.2 Blood Haemoglobin

A person's haemoglobin level can reveal whether or not they are anaemic. The process of making haemoglobin takes place in the bone marrow and is sensitive to both inflammation and the availability of iron (Thurnham, 2009). The most often used indication to check for IDA (Iron Deficiency Anaemia) is the amount of haemoglobin (Hb) in the blood (WHO, 2004). The haemoglobin and iron storage tests should be included in the medical examination of female athletes, and they should be repeated whenever an athlete's endurance performance falls off for no apparent reason (Fox, 1981; Morton *et al*., 1989). According to Muratee (1990), iron deficiency anaemia reduces human labour capacity and impairs infection resistance.

If the haemoglobin level is below 12 g/dl for women or 13 g/dl for men, true anaemia exists in athletes. Sports anaemia is characterised by a brief decrease in haemoglobin due to an acute stress reaction to activity that reduces the blood's ability to carry oxygen. According to Chandrasekhar and Shanthi (1992), three of the five groups of athletes they evaluated had mean haemoglobin readings that were below normal, but dietary changes dramatically improved the situation.

### 2.2.3 Diet Survey

By giving information on nutrient intake levels and sources, diet surveys serve as the most basic yet crucial component of any comprehensive investigation of an individual's or a group's nutritional status (Swaminathan, 1985; Robinson et al., 1990; Brahmam *et al*., 1987). The weighting of raw foods has been a popular approach of diet survey, according to Parvathi Rau (1984). Kinard, *et al.* (1990) assessed nutritional intake using two- or three-day dietary recalls, while questionnaire research was employed to examine qualitative and quantitative changes in food consumption and meal frequency in connection to emotional state.

According to a 2004 study by Hinton *et al*., on female collegiate athletes, their food intake was severely deficient. Studies by Hickson *et al*., (1987), Keith and Lynn (1989), and Young (1986) have also demonstrated that athletes had only minimal dietary intakes of numerous nutrients like energy, protein, magnesium, iron, and zinc. The majority of the athletes in a research by Leed (1991) who used a 24-hour recall on them had poor nutritional intakes. According to Gregory (1991) and Jacobson *et al*., (2001), attitudes and nutritional knowledge have a significant impact on dietary intake.

When Perron and Endres (1985) evaluated 14 different athletic diets, they discovered that they were high in cholesterol and saturated fat. Female gymnasts' diets were shown by Mofat (1984) and Fischer *et al*., (1995) to be nutritionally poor because they lacked vitamin B6, folic acid, calcium, iron, zinc, and magnesium. In their study comparing the dietary consumption of men and women, Nowak *et al*., (1988) discovered that the mean percent RDA of all nutrients, with the exception of vitamin A and D, was higher for men. As a result, it is recommended that female athletes receive counselling (Clark, 1999).

## 2.3 Prevalence of Iron Deficiency Anaemia Among Sports Women

According to Antonio *et al*., (2001), anaemia is the most frequent medical ailment among athletes, particularly female athletes. According to Boyadjiev and Taralov (2001), athletes had lower haemoglobin concentration and red blood cell counts than inactive people, which may support the idea that activity increases the body's need for iron beyond what it can consume. In high risk groups, screening for early indications of iron deficiency as well as appropriate supplementation and dietary advice is necessary (Cowell *et al*., 2003; Clark, 1999).

The incidence of anaemia is a global issue that affects both emerging and industrialised nations, although it is significantly lower in the latter than in the former (Durrain, 1993). Anaemia is one of the most significant public health challenges on the dietary agenda, affecting around 1.3 billion people worldwide (WHO, 2001). Controlling nutritional anaemia should be one of the global development objectives to be accomplished in the early years of the new millennium, the United Nations has reiterated (Krause *et al*., 2004). According to Rajagopalan (2009), the region in the globe with the highest prevalence of iron deficiency anaemia is in South Asia, which includes India. There is a relatively high frequency among school-age children and adolescents in South Asian nations, particularly in India (50-90%), Bangladesh (40-74%), and Sri Lanka (58%) (Florentino, 2003). Over 320 million people in India are affected by iron deficiency anaemia (IDA), which affects 60–70% of children, 50–60% of teenage girls, and 40–80% of women (NNMB, 2008).

Due to their higher demands, female athletes are more likely to get sports anaemia than male athletes (Magnusson *et al*., 1984). According to a research by Keith and Lynn (1989) on the dietary status of trained female cyclists, the diets of female athletes were deficient in iron, zinc, and magnesium.

### 2.3.1 Causes and Consequences of Sports Anaemia

According to Haymes *et al*., (2006), one of the most common nutritional deficits among athletes, particularly women, is iron depletion (low iron reserves). Iron depletion and the subsequent drop in haemoglobin to anaemic levels are frequently referred to as "sports anaemia." Red blood cell (RBC) count and haemoglobin concentration have been demonstrated to be lower in athletes than inactive individuals, and sports anaemia arises in athletes who drastically increase their training intensity (Smith, 1995; Elliot *et al*., 1991). Because of increased demand for more total body haemoglobin, intestinal losses from sweating, menstrual losses in female athletes, and low nutritional intake, athletes may be at risk for developing an iron shortage (ADA, 2005). According to Kimberly and Mueller (2006), depletion of iron reserves is unavoidable because 75% of women between the ages of 18 and 44 don't consume enough meals high in iron. Iron deficiency is mostly brought on by inadequate dietary iron consumption (Dallman, 1992).

A time during the early phases of training when athletes may experience low blood haemoglobin levels is known as sports anaemia; this is likely a typical response to physical training. According to Braun *et al.*, (2000), aerobic exercise increases blood volume, which results in a decrease in the RBC count per unit of blood due to the additional fluid. When the amount of haemoglobin goes below what is considered normal for the person's age and sex, anaemia is said to be present. Long-term, intense exercise, such as everyday endurance training, can cause athletes to lose some red blood cells.

Reduced Hb synthesis, enhanced RBC oxidation, and plasma volume expansion are a few potential reasons of sports anaemia. This disorder can worsen with a low-iron diet. Athletes may also experience iron depletion and increased iron losses through urine, sweat, internal bleeding, injuries, and other mechanisms (Lamanca *et al.,* 1998; Waller and Haymes, 1996). A diet low in iron, poor absorption, or accelerated iron loss are the main contributors of so-called sports anaemia. Numerous factors contribute to low iron levels in the body, which manifest as symptoms when iron deficiency anaemia first appears. Athletes are a unique population with extra factors that can contribute to iron or blood loss, such as increased perspiration, "foot strike hemolysis," and occasionally malnutrition (Selby and Eichner, 1986).

About 3–5 g of iron can be found in a human body. The majority of this (80%) is found in haemoglobin (Hb), which boosts blood's ability to carry oxygen by around 65 times and also

plays a role in other crucial exercise-related processes. Myoglobin, a substance related to haemoglobin that helps transport oxygen inside muscle cells, contains iron as a structural component (Patterson *et al*., 1998). It is found in trace amounts in cytochrome, a specialised chemical that serves as a catalyst in the energy transfer system and supplies the energy needed for work performance. According to recent studies, endurance exercise increases the need for iron, a need that many athletes are unable to fill (Cowell *et al.,* 2003).

Only 15% of the iron that is consumed is really absorbed, which makes the situation much more complicated. Absorption depends on the type of iron consumed (plant versus animal), the make-up of the meal, and the iron status of the person. Many different foods, both those of animal and plant origin, contain iron (Kleiner, 1995). It is well known, however, that iron from animal sources, also known as haeme iron, is better absorbed than iron from plant sources by up to 20% more (Hurrel, 1997; Cook *et al.,* 1991). According to Larson - Meyer (2007), vegetarian athletes still run a higher risk of iron shortage even if their overall iron intake is the same.

According to Lynch and Cook (1980) and Gertser (1989), eating foods high in vitamin C, such as citrus fruits and juice, can help vegetarians better absorb iron. Contrarily, a number of food compounds, such as tannic acid, which is present in tea and coffee, food additives like phosphate, which is included in soft drinks, and food preservatives, may impede iron absorption by as much as 50%. With excessive use of other minerals (such as zinc and calcium), iron absorption is also lowered. The degree of iron depletion has an impact on how much iron is absorbed, therefore people with deficiencies will absorb more iron than those who are healthy.

### 2.4 Menstrual distress among athletes

In their 2018 study, Dehnavi and Sadeghi set up a quasi-experimental design. The participants were chosen from a group of forty non-athletic female students, all of whom ranged in age from 18 to 25. K Azad University conducted the study to address PMS. Before and throughout training, responses to the PMS, GHQ, and Beck Depression and Anxiety questionnaire were recorded. For eight weeks, aerobic exercise was administered to the experimental group. There were three classes every week, lasting sixty minutes apiece. Pre, Mid, and Post-test evaluations of the subjects were conducted. After giving the experimental group eight weeks of training, there was a substantial difference for both groups (i.e., control and experimental) in the

psychological and somatic symptoms of PMS. The results showed that aerobic training for eight weeks reduced the unpleasant symptoms of PMS, making it one of the greatest treatments for the condition (Mohebbi Dehnavi, 2018).

It has been noted by Safarzadeh *et al*., (2016) that exercise and PMS are related. On 160 medical students from Zahedan University, an analytical study with a descriptive focus was conducted. In the years 2014–2015, this study was conducted. Out of the total number of students, forty-four have exercised very little, or less than twice per week, and have engaged in physical activity two to four days per week. A total of thirty pupils exercised more than four times as often as the average student. A total of 120 patients experienced dysmenorrhea during the menstrual cycle. Exercise and PMS were found to have a significant connection ($p = 0.08$). According to the findings, sports and regular exercise are the most effective treatments for PMS (Safarzadeh, 2016).

The effects of a 12-week yoga fitness programme on premenstrual symptoms in females in Taiwan were examined by Tsai (2016). 64 participants in a yoga intervention reported having menstrual pain 90.6% of the time. After the intervention, individuals reported using analgesics less frequently (P=0.290) and that moderate to severe menstrual pain had less of an impact on their ability to function (P=0.0011). The Yoga exercise intervention significantly reduced abdominal swelling (P=0.0011), breast tenderness (P=0.0348), abdominal cramps (P>0.0018), and cold sweats (P=0.0143) in addition to improving physical function (P=0.0340) and bodily discomfort (P=0.0087) on the SF-36 scale. Following the yoga intervention, there was a reduction in menstrual discomfort, which improved on six SF-36 scales.( Tsai, 2016)

The Yoga exercise intervention was associated with the improvement of scale physical function (P=0.0340) and bodily pain (P=0.0087) of SF 36 and significantly decreased abdominal swelling (P=0.0011) breast tenderness (P=0.0348), abdominal cramps (P>0.0018) cold sweats (P=0.0143). Menstrual pain was decreased after the yogic intervention and correlated with improvement in six scales of SF-36."(S. Tsai, 2016)

In their 2015 study, Kannan, P. *et al*., investigated the role that exercise has in reducing PD-related menstruation discomfort. Three times per week for one month, the subjects received intense aerobic exercise on a treadmill in the lab; this was followed by one month of aerobic exercise at home. For three menstrual cycles, the short-form McGill Pain Questionnaire was utilised to assess pain. According to the findings, there was a total of 100 percent adherence to both the clinic-based and prescription-based interventions, with an overall adherence rate of 98

percent and a home exercise training programme adherence rate of 96 percent. There was discovered to be a 100% retention rate. The findings indicated that the intervention was both workable and applicable. After intervention, there was a favourable change. Kannan (2015)

Cross-sectional research was conducted by Kusum Sachin *et al*., (2014) to determine the impact of consistent exercise on PMS in premenopausal women. 100 healthy premenopausal women between the ages of 30 and 40 were chosen as a sample, and they were split into two groups: the exercising group and the non-exercising group.A total of 50 girls from the Mangalore fitness and health centres were chosen for the experimental group, while a total of 50 other healthy females who did not exercise were chosen for the control group. The experimental group received a regimen for aerobic activity. 5 minutes of warm-up, 45 minutes of limb and trunk rapid activity, and 10 minutes of cool-down were included. Total 60 minutes schedule thrice in a week for 6 months was given. Premenstrual syndrome questionnaires were given to all participants. Results of the study concluded that premenstrual symptoms named behavioural, physical and psychological were found low significantly ($P<0.001$) in the experimental group as compared with a control group and the results have also revealed that skin changes in exercisers were found less ($P<0.01$) as compared with non-exercisers (Kusum Sachin, 2014).

To determine the impact of aerobic exercise on menstruation discomfort, Soni *et al*., (2014) conducted a study among adolescent girls between the ages of 18 and 20. Sixty girls were chosen, and then two groups—the study group and the control group—were created. 30 students made up each group, and they were chosen via stratified sampling. Menstrual distress post-test 1 and post-test 2 mean scores were found to be 62.63 and 40.77, respectively, which is quite low compared to the mean score of 84.10 prior to aerobic exercises. The findings made it abundantly evident that teen girls' menstrual suffering has decreased as a result of their utilisation of aerobic workouts. Additionally, according to the findings, there is no link between menstruation distress and demographic factors. (Soni, 2014)

Mindy (2008) researched the subject "Effects of exercise participation on menstrual pain and symptoms" and chose for the study 21 inactive and 20 active women. The Impact and Severity of Menstrual Symptoms (PRISM) record was kept by the authors for two menstrual cycles. When compared to the follicular and luteal phases, menstruation was found to be the only time when women had significant pain, and exercise was found to be quite helpful in reducing pain for active women as opposed to sedentary ones.(Mindy, 2008)

Premenstrual diseases, symptoms of PMS, and treatments for PMS were reviewed in Frackiewicz, et al.'s research on evaluation and management of PMS and PMDD from 2001. Premenstrual Dysphoric Disorders (PMDD) were discovered to affect roughly 5% of women. They suggested changing one's diet and engaging in physical activity to alleviate symptoms. They also came to the conclusion that we could manage these symptoms by spreading knowledge about PMS and encouraging women to incorporate exercise into their daily routines in order to combat PMS. (Frackicwicz 2002)

Aman *et al.,* (2005) carried out and examined a study on young college girls in Peshawar to determine the prevalence of premenstrual syndrome. 384 samples were chosen for analysis. The sample completed a Moos Menstrual Distress Questionnaire-based, 29-item abbreviated Premenstrual Assessment questionnaire for two cycles. Data showed that 53% of women had PMS, with 42% having mild symptoms, 18.2% having moderate symptoms, and 31.7% having severe symptoms. Body aches, anxiety, back pain, depression, and weariness were frequent symptoms. Thus, the findings suggested that PMS is one of the frequent issues affecting adolescent girls (Aman , 2005).

In the study "Comparison of Prevalence of Premenstrual Syndrome in Swimmer and Non-Swimmer Students" published in 2008, Khademi *et al.,* assessed the PMS symptoms of female students who were not swimmers and swimmers. With a mean age of 20.6 ± 3.1 years, there were 280 pupils. 140 swimmers and 140 non-swimmers, respectively, were divided into the two groups, dubbed experimental and control. The results of the pre-test showed that the PMS scores for swimmers and non-swimmers, respectively, were 22.8 and 36.2 percent (p=0.00). Thirteen (13.9%) non-swimmers and 35 (25%) swimmers did not report any PMS symptoms. 48 non-swimmers (i.e., 17.1%) were found to have PMS (P=0.00), compared to 11 (7.9%) swimmers who reported problems with more than half of the questionnaire items. Comparing swimmers to non-swimmers, it was discovered that swimmers experienced much less PMS.

Ghanbari et al., (2008) studied the impact of three months of consistent aerobic exercise on PMS symptoms in 89 volunteer women with normal menstrual cycles. For PMS, a modified version of the menstrual distress questionnaire (MMDQ) was employed. The 89 women were divided into two groups: the exercised group, which included 41 women, and the non-exercised group, which included 48 women. The exercise group received the intervention for three months, 12 times (or three times per week), for each month, lasting an hour each time. The

PMS of the two groups was compared. Prior to and following the intervention, the P value was found to be significant at 0.05.

It was understood that, there is a significant difference between athletes and non-athletes with respect to nutritional status, anaemia and menstrual distress. As there are not many studies which have been done regarding comparison of menstrual distress and dietary patterns among athletes and non-athletes in the state of Kerala, this particular study was conducted in kerala and the methodology of the study is presented in the subsequent chapter.

# METHODOLOGY

# CHAPTER - 3

# METHODOLOGY

By "systematic and logical approach followed in the process of scientific investigation that incorporates various steps and techniques to collect, analyze, and interpret data to answer research questions or test hypotheses," Kothari (2004) defined research methodology. It is "the theoretical analysis of the methods appropriate to a field of study or to the body of methods and principles particular to a branch of knowledge" (Pickett, 2000). The methodology pertaining to the study entitled “Menstrual Distress among Athletes and Non-Athletes – A Comparative study” can be discussed under the following heads.

## 3.1 Selection of Area

The study was conducted among Athletes and non-Athletes residing in three districts of Kerala State. These districts included Ernakulam, Kottayam and Idukki District. The criteria for the selection of the three districts included availability of subjects in the athlete category across the districts.

## 3.2 Selection of Subjects

For the purpose of the study, unmarried, healthy females belonging to the age group of 18 to 23 years comprising equal number of Athletes and non-Athletes were included.100 Subjects were selected for collecting data to obtain representativeness of the target population, to ensure that the findings can be generalized and can accurately reflect the characteristics, diversity, and variability present in the population of interest. To facilitate comparison of Nutritional Status and Menstrual distress between Athletes and non-Athletes, 50 Athletes and non-Athletes were selected as subjects for the study.

### Inclusion Criteria

- The subjects for the study comprised College going girls, in the age group of 18 to 23 years.
- Individuals competing in any individual or team sport, or well-trained individuals who demonstrate a high level of conditioning or train at least four times per week.

**Exclusion Criteria**

- Persons with any metabolic disease and Pregnancy

### 3.3 Selection of Tools and Techniques

#### 3.3.1 Sampling Technique

The techniques used for sampling was , Purposive non-random sampling. Purposive sampling, according to Verma *et al*., (2017), is a non-probability technique that entails the deliberate selection of participants for a study by the researchers based on pre-specified criteria, such as having the necessary experience and being able to explain a particular theme, concept, or phenomenon that the researchers are interested in.

#### 3.3.2 Selection of Tools

According to Kumar (2006), an interview is broadly described as a face-to-face verbal exchange between two people: the interviewer, who is the researcher, and the respondent, who is the interviewee. The interviewer tries to get the responder to provide the necessary details about the study issue. Although it seems like a chat, this one is more focused on a single objective. The tools which were used for the study included a combination of questionnaire and interview method. A questionnaire, in the words of Krishan (1992), is "a written document listing a series of questions pertaining to the problem under study, to which the investigator requires the answers". The Questionnaire used to collect data is provided in Appendix 1.

The various sections in the questionnaire were categorised as:

1. Sociodemographic data – Kuppuswamy SES 2022
2. Anthropometric Assessment
3. Biochemical data
4. Menstrual Distress Data
5. Dietary Assessment

A pilot study was conducted before undertaking the full-scale project. Pilot study was conducted among ten students from St.Teresa’s College, Ernakulam as a preliminary

investigation to assess the feasibility, validity, and reliability of the research design and methods.

## 1. SOCIODEMOGRAPHIC DATA

### Kuppuswamy's Socioeconomic scale. 2022

The details pertaining to the Kuppuswamy's Socioeconomic scale are included in Appendix 2 of the study. The most extensively and frequently used scales in India for measuring socioeconomic class are "Updated Modified Kuppuswamy SES," which is primarily utilised for urban areas. This scale, created by Kuppuswamy in 1976, considers a number of factors to assess the socioeconomic standing of an individual or household. A standardised framework for gauging socioeconomic level is provided by the Kuppuswamy scale. It takes into account a number of variables, including those that are widely acknowledged as being important markers of socioeconomic position, like education, occupation, and income. This standardisation enables comparisons between various people, homes, and studies.

Based on the scoring of Kuppuswamy socioeconomic status scale (2022) the subjects were categorized into different categories like Upper, Upper Middle, Lower Middle, Upper lower and lower socio-economic strata as depicted in Table 1 .

**Table 1: Socioeconomic Class based on Kuppuswamy SES 2022**

| Sl.No. | Total Score obtained | Socioeconomic Class |
|---|---|---|
| 1. | 26-29 | Upper |
| 2. | 16-25 | Upper Middle |
| 3. | 11-15 | Lower Middle |
| 4. | 5-10 | Upper Lower |
| 5. | <5 | Lower |

## 2. ANTHROPOMETRIC ASSESSMENT

The study of measuring the human body's dimensions in terms of bone, muscle, and adipose (fat) tissue is known as anthropometry. Subcutaneous adipose tissue measurements are crucial because those with high levels have been linked to a higher risk of developing cancer,

gallstones, adult-onset diabetes, hypertension, cardiovascular disease, and other conditions. Anthropometry is crucial information that is required in conjunction with food and questionnaire data, biochemical results, and other information to help describe the data gathered from individuals. Athletes' body composition can also be determined using anthropometric measurements, which has been demonstrated to improve athletic performance in competition and reveal underlying medical issues like eating disorders. Athletes' cardiorespiratory fitness and strength have been demonstrated to improve with anthropometry-driven exercise regimens. In order to evaluate obese patients and pregnant women's nutritional health, anthropometric measurements are frequently performed.

**Height**

To ensure dependability and accuracy, the World Health Organisation (WHO) and the Centres for Disease Control and Prevention (CDC) have put into place standardised processes for measuring body height. An individual's height or stature is a genetic trait that can have clinical effects on determining body mass index (BMI), nutritional status, and underlying illnesses in both children and adults.

**Procedure**

With the aid of a stadiometer, respondents' height was measured. The subject was in a standing position, unaided, with the back of the head, heels, buttocks, and thoracic area in touch with a vertical wall. Arms were crossed and heels remained close together. Throughout the measurement, the patient inhaled deeply while maintaining a straight face. The subject's height was calculated as the distance from the standing platform to the vertex, which is the highest point on the skull. To the closest millimetre, the height was measured.

**Weight**.

An important anthropometric measure of body mass is weight. It can be used to diagnose acute protein-calorie malnutrition in children of all age groups since it is a sensitive indicator of malnutrition.

**Procedure**

All subjects were dressed simply when their body weight was determined using 0.1 kg precision weighing scales. At the centre of the scale, the figure took an upright stance. To the

nearest kilogramme, the body weight was measured. Prior to the weigh-in, many took off their shoes and bulky clothing.

**Body Mass Index**

Body Mass Index (BMI) is a measurement of body composition that links lean body mass to a person's weight and height. Thus, the BMI is a weight index that has been structurally corrected. By dividing weight in kilogrammes by height in metres squared, the body mass index is calculated. BMI does not make a body fat or health diagnosis for a person, but it does screen for weight categories that may cause health issues.

$$\text{Body Mass Index (BMI)} = \frac{\text{Wt. in Kg.}}{\text{Ht. in (m)}^2}$$

**Table 2 - Classification of Subjects Based on Body Mass Index**

| **Classification** | **BMI (kg/m$^2$)** |
|---|---|
| Under weight | < 18.5 |
| Normal | 18.5- 24.9 |
| Pre obesity | 25.0 – 29.9 |
| Obesity class I | 30- 34.9 |
| Obesity class II | 35- 39.9 |
| Obesity class III | ≥ 40 |

World Health Organization, 2010

For various groups, there are varying relationships between BMI, body fat %, body fat distribution, and health concerns. Asian ethnicities, who tend to have relatively low BMIs but high levels of abdominal fat, appear to have a particularly high prevalence of central obesity. As a result of these ethnic variations, a WHO expert consultation came up with an alternative set of criteria for Asian populations as given in Table 3.

**Table 3 – International (IOTF) Body Mass Index Cut-Offs for Thinness, Overweight and Obesity**

| Classification | BMI |
|---|---|
| Underweight | < 18.5 |
| Normal range | 18.5 – 22.9 |
| Overweight | ≥ 23 |
| At risk | 23 - 24.9 |
| Obesity Class I | 25 - 29.9 |
| Obesity Class II | ≥ 30 |

Asia Pacific report (WHO, IASO, IOTF 2000)

## BIOCHEMICAL DATA

### Haemoglobin

For the purpose of identifying anaemia or high haemoglobin levels, the measurement of haemoglobin concentration is crucial. Osmosis allows water molecules from the alkaline ammonia solution to enter red blood cells. Red cell membranes are split as a result, releasing haemoglobin into the fluid. Colorimetry can then be used to measure the haemoglobin.

**Specimen:** Blood is often drawn by venepuncture or finger pricking. Blood must be drawn into an anticoagulant, such as heparin or EDTA. Haemoglobin can be estimated using a variety of techniques in the lab. The individuals' haemoglobin was calculated using the cyanmethemoglobin technique.

### Cyanmethemoglobin method

Stadie first suggested the cyanmethemoglobin method in 1920. Separate alkaline ferricyanide and cyanide reagents were utilised in this procedure. Drabkin and Austin first introduced a reagent in 1935.This technique for measuring haemoglobin is accepted worldwide. Blood haemoglobin was the parameter that was examined for the purpose of biochemical evaluation. In the study's Appendix 3, the method for measuring haemoglobin that was used is described.

**Table 4: WHO Classification of Anaemia**

| Population | Non- anaemic | Mild | Moderate | Severe |
|---|---|---|---|---|
| | | Anaemia | | |
| Non pregnant women 15 years of age and above | 12g/dl or higher | 11-11.9 g/dl | 8-10.9 g/dl | Lower than 8 g/dl |

WHO, 2011

## 4.MENSTRUAL DISTRESS ASSESSMENT

Menstrual discomfort, according to Kordi *et al*., (2011), involves behavioural, psychological, and physical symptoms whose contributing elements have been grouped based on a bio-psychological and social model. According to this model, menstrual distress symptoms are found to be influenced by a variety of biological factors, such as hormonal disorders and lifestyle choices that affect physical activity and nutritional status, in addition to psychological factors like anxiety, depression, and environmental stress as well as social factors like interactions with friends, family, and coworkers and attitudes towards menstruation. Francis(2003). Hormonal imbalance is the root cause of many symptoms experienced during menstruation, including anxiety, depression, stress, reduced confidence, and behavioural changes (Deci & Ryan, 2008).

In their patient information leaflet, the American College of Obstetricians and Gynaecologists note that "for many women, aerobic exercise lessens PMS symptoms," yet they do not specify the frequency or duration of exercise needed to experience symptom relief. Similar to the United States, the UK's NHS direct website advises women on potential treatments for menstrual pain and notes that "moderate physical activity may help with pain relief." Regular exercise has been found in studies involving general populations to relieve some of the PMS symptoms that are frequently experienced by women, such as mood disturbance, exhaustion, cognitive dysfunction, and bloating.

**MOOS Menstrual Distress Questionnaire**

Menstrual cycle research has frequently employed the Moos Menstrual Distress Questionnaire (MDQ) (Moos, 1968; 1985) (Markum, 1976; Logue & Moos, 1986).According to Moos (1985), the original scale (T form) was "appropriate for repeated assessment of women's reactions over time" and required daily ratings of symptoms using a 6-point Likert scale. The scale was created by selecting the most often reported menstruation symptoms through the use of an open-ended questionnaire, an interview, and/or a review of previous studies (Moos, 1968). Women were asked to score their experiences with 47 different things for each phase of their menstrual cycle. Following ratings analysis, eight scales of "empirically related items" were produced.

A five-point likert type scale (0–4) ranging from "no experience of symptoms" to "very severe" throughout a total of 47 statements is used by the MDQ to ask individuals to rate their symptoms. Each subject rated each phase of her most recent menstrual cycle separately (during, menstruation, remainder of cycle). Pain, water retention, autonomic reaction, negative affect, reduced focus, behavioural change, arousal, and control are the eight scales of the MDQ. The scores from each of the eight scales were computed separately, and then the overall scores were computed.

**Table 5 – Sub-scales of Menstrual Distress Questionnaire**

| Pain | Concentration | Behavioural changes | Autonomic reactions |
|---|---|---|---|
| Muscle stiffness | Insomnia | Lowered school or work performance | Dizziness, faintness |
| Headache | Forgetfulness | Take naps, stay in bed | Cold sweats |
| Cramps | Confusion | Stay at home | Nausea, vomiting |
| Backache | Lowered | Avoid social activities | Hot flashes |
| Fatigue | Difficulty concentrating | Decreased efficiency | |

| | | | |
|---|---|---|---|
| General aches and pains | Distractible | | |

| Water retention | Negative effect | Arousal | Control |
|---|---|---|---|
| Weight gain | Crying | Affectionate | Feeling of suffocation |
| Skin disorders | Loneliness | Orderliness | Chest pains |
| Painful breasts | Anxiety | Excitement | Ringing in the ears |
| Swelling | Restlessness | Feelings of well-being | Heart pounding. |
| | Irritability | Bursts of energy, activity | Numbness, tingling |
| | Mood swings | | Blind spots, fuzzy vision. |
| | Depression | | |
| | Tension | | |

Ross (2003)

**Table 6: Interpretation of MOOS MDQ**

| Score | Intensity of Menstruation sign |
|---|---|
| $\leq$16 | Minor menstruation signs |
| >17 to <32 | Moderate menstruation signs |
| >33 to <48 | Acute menstruation signs |
| >49 | Very acute menstruation signs |

Kordi (2011)

## 5. DIETARY ASSESSMENT

### 24 Hour dietary recall Questionnaire

A structured interview called a 24-hour dietary recall (24HR) is used to gather thorough information about all the respondent's recent 24-hour food and beverage intake. This open-ended response format is intended to encourage responders to give a thorough and in-depth

account of all foods and drinks ingested. The purpose of the diet surveys was to assess the subjects' calorie, carbohydrate, protein, fat, calcium, and iron intake.

**Procedure**

The portion quantity of each food and beverage is recorded in addition to additional specific identifiers like the time of day and the food's origin. To aid respondents in judging and reporting portion size and to increase accuracy, visual aids such as food models, photos, and other images may be employed. Dietary recalls frequently begin with questions about foods and drinks before moving on to inquiries regarding dietary supplements.

• Surveys and analyses can be designed to incorporate information on food sources and preparation techniques.

• 24HRs provide quantitative estimates of each person's food consumption and nutrient intake.

• Can take into consideration foods eaten together that might increase or decrease the absorption of micronutrients

The foods consumed for various meals as well as the amount of food consumed were asked about from the respondents. The quantity of raw components was then measured out using the usual volumetric measurements. Later, this was changed into grammes. Additionally, the amount of the cooked food was measured. This was likewise done using domestic measurements before being modified to utilise standard measurements. The amount of prepared food consumed by the subject was then measured in household units and converted to standard volumetric units. The subject's intake of raw components was determined using this data. Nutritive value of the foods consumed by the samples were calculated based on the value given in the food consumption tables of the Indian Food Composition Table ( IFCT) 2017.Nutrient intakes were computed using NSR NutriCal Version 4. This tool helps in improving efficiency & productivity of dietary calculations and assessment. It is an innovative online educational tool based on IFCT 2017 for convenient, precise and quick nutrient analysis.

**HEI (Healthy Eating Index)**

Healthy Eating Index (HEI), was used to find out how well the Americans follow the recommended healthy eating patterns. The total possible score for the overall index ranges from 0 to 100. The range of scores for each of the 10 dietary components is from 0 to 10. Individuals that consumed the recommended amount of fluids earned a maximum of 10 points. When none of the meals in a group were consumed, a score of zero was given. Scores at intermediate levels were proportionally determined. The HEI-2005's components were divided into two categories. Because the recommendations on which they were based were created to promote adequate nutrient intake, the food-group and Oils components were referred to as "adequacy components". Saturated Fat, Sodium, and Calories from SoFAAS were the "moderation components".

**Table 7 - Components of HEI -2005 with maximum and minimum scores**

| **Components** | **Max Score** | **Min Score** |
|---|---|---|
| Total Fruit | 5 | 0 |
| Whole Fruit | 5 | 0 |
| Total Vegetables | 5 | 0 |
| Dark Green and Orange Vegetables and Legumes | 5 | 0 |
| Total Grains | 5 | 0 |
| Whole Grains | 5 | 0 |
| Milk | 10 | 0 |
| Meat and Beans | 10 | 0 |
| Oils | 10 | 0 |
| Saturated Fat | 10 | 0 |
| Sodium | 10 | 0 |
| Calories from SoFAAS | 20 | 0 |
| **Total HEI Score** | **100** | **0** |

Guenther, P.M. (2007)

**Table 8: Interpretation HEI Score**

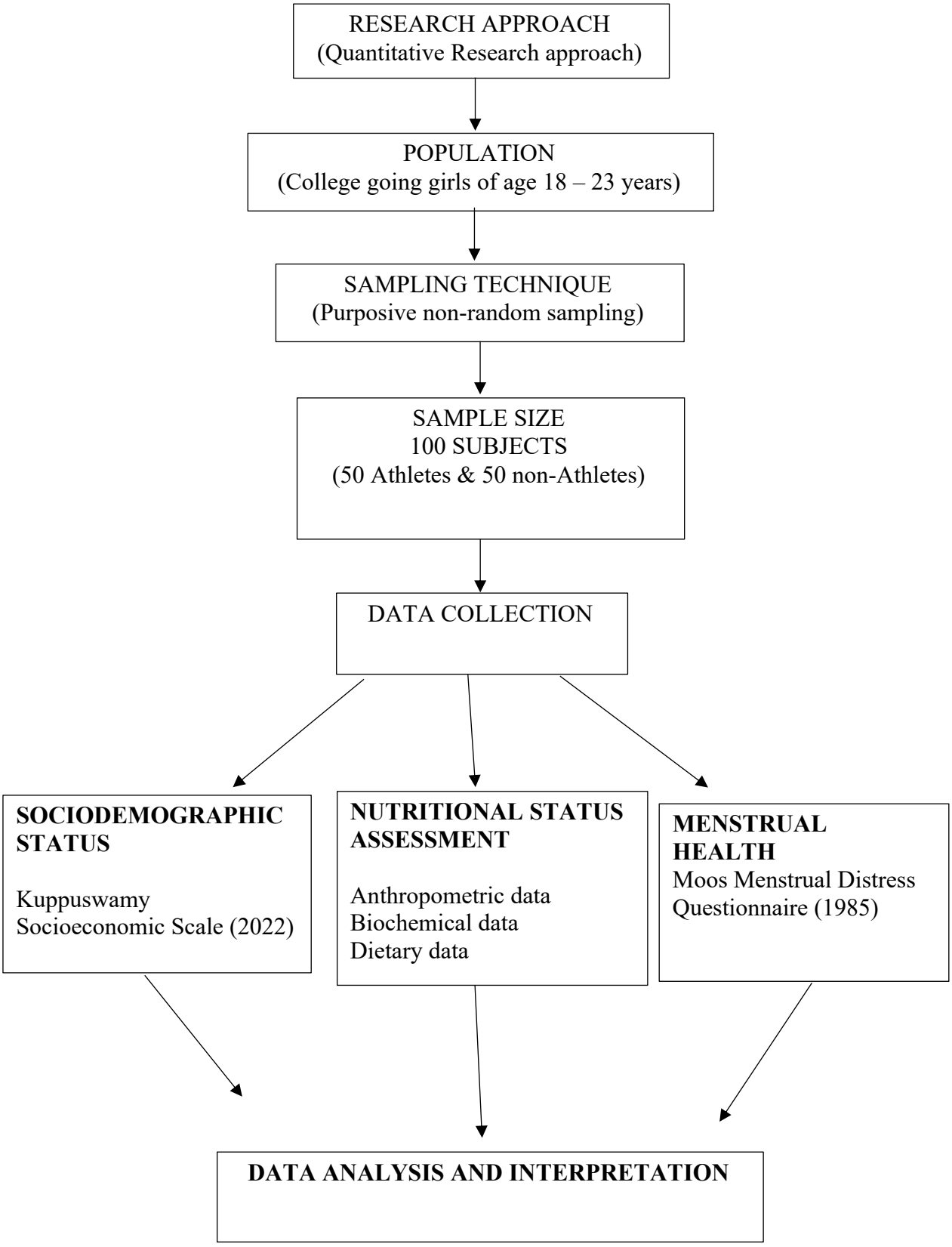
| **Score** | **Quality of diet** |
|---|---|

| | |
|---|---|
| >80 | Good quality diet |
| 51 – 80 | Diet needs improvement |
| =50 / <50 | Poor quality diet |

**Statistical Analysis:**

Data were analyzed using SPSS version 25 for Windows (version 25, 2017, IBM Corporation, Armonk, New York, United States). Data presented as frequency (percentage) or Mean±SD. Differences in continuous parameters between athletes and non-athletes was assessed using Independent Sample T test. Differences in food cravings and MOOS scores between athletes and non-athletes were assessed using Mann Whitney U test. Cross tabulations were computed for categorical variables and compared using chi-square test. Changes in MOOS score over 3 phases were assessed using Wilcoxon Sign Ranked Test. $p<0.05$ was considered statistically significant.

**RESEARCH DESIGN**



# RESULT AND DISCUSSION

# CHAPTER 4
# RESULTS AND DISCUSSIONS

**Results:**

**Table 9: Background Information of study subjects using Kuppuswamy SES**

| Categories | Frequency | Percentage |
|---|---|---|
| **Type of family** | | |
| Nuclear | 79 | 79 |
| Joint | 19 | 19 |
| Extended | 2 | 2 |
| **SES** | | |
| Upper lower | 10 | 10 |
| Lower middle | 45 | 45 |
| Upper middle | 45 | 45 |
| **No: of family members** | | |
| 2 | 1 | 1 |
| 3 | 9 | 9 |
| 4 | 51 | 51 |
| 5 | 22 | 22 |
| 6 | 4 | 4 |
| 7 | 4 | 4 |
| 8 | 7 | 7 |
| 9 | 2 | 2 |
| **Food pattern** | | |
| Vegetarian | 2 | 2 |
| Non-vegetarians | 88 | 88 |
| Lacto-vegetarian | 4 | 4 |
| Ovo-vegetarian | 6 | 6 |

From the data collected from 50 Athletes and non-Athletes, 10 percent of the population were of Upper lower class, 45 percent of population were of Lower middle class and 45 percent of the population were of Upper middle class. Among the participants, 79% belonged to nuclear families, indicating a prevalence of small, independent family units. Joint families represented 19% of the sample, reflecting a more extended family structure, while only 2% belonged to extended families. The study also captured data on family size, revealing that families with four members were the most common (51%), followed by families with five members (22%). The remaining family sizes were relatively smaller, with varying frequencies. On studying the food patterns of the subjects, it was found that 88% of them were non-vegetarians. Only 2% were vegetarians and the remaining 6% and 4% were Ovo-vegetarians and Lacto-vegetarian respectively.

**Table 10: BMI Classification of the subjects**

| **BMI Categories** | **Frequency** | **Percentage** |
|---|---|---|
| Underweight <18.5 | 23 | 23 |
| Normal 18.5 - 22.9 | 48 | 48 |
| Overweight 23 - 24.9 | 12 | 12 |
| Obese >25 | 17 | 17 |

The BMI (Body Mass Index) classification provides an overview of the weight status of the study subjects. The data reveals that 23% of the participants were classified as underweight, indicating a lower than normal body weight. Nearly half of the participants (48%) fell into the normal weight range, suggesting a relatively healthy weight status. A smaller percentage (12%) were classified as overweight, indicating a higher body weight than the ideal range. Additionally, 17% of the participants were categorized as obese, signifying a significantly higher body weight that may pose health risks.The classification helps identify potential weight-related health risks and provides a foundation for further analysis and intervention.

**Table 11: Disordered health Conditions among the study subjects**

| Criteria | Frequency | Percentage |
|---|---|---|
| **Stress fractures** | | |
| Yes | 6 | 6 |
| No | 94 | 94 |
| **Eating disorders** | | |
| Yes | 16 | 16 |
| No | 84 | 84 |
| **Low bone density** | | |
| Yes | 10 | 10 |
| No | 90 | 90 |
| **Asthma** | | |
| Yes | 10 | 10 |
| No | 90 | 90 |
| **Oligo/amenorrhoea** | | |
| Yes | 15 | 15 |
| No | 85 | 85 |
| **ACL Rupture** | | |
| Yes | 4 | 4 |
| No | 96 | 96 |
| **Haemochromatosis** | | |
| Yes | 1 | 1 |
| No | 99 | 99 |
| **Depression/Anxiety** | | |
| Yes | 14 | 14 |
| No | 86 | 86 |
| **Hypothyroidism** | | |
| Yes | 6 | 6 |
| No | 94 | 94 |
| **Concussion** | | |

| | | |
|---|---|---|
| Yes | 0 | 0 |
| No | 100 | 100 |

From the data collected from the 100 study subjects, it was found that 16% and 6% had eating disorders, and stress fractures respectively. 10% of the participants were diagnosed with Asthma and Low bone density. Further on, on studying the mental health among the study subjects 14% had depression and anxiety. No subjects had experienced concussion.

**Table 12 : Consumption of supplements among the Sports subjects (50 subjects)**

| **Criteria** | **Frequency** | **Percentage** |
|---|---|---|
| **Creatine** | | |
| Yes | 4 | 4 |
| No | 46 | 46 |
| **Protein** | | |
| Yes | 18 | 18 |
| No | 32 | 32 |
| **Vitamins and Minerals** | | |
| Yes | 26 | 26 |
| No | 24 | 24 |
| **Probiotics** | | |
| Yes | 10 | 10 |
| No | 40 | 40 |
| **Glucosamine** | | |
| Yes | 0 | 0 |
| No | 50 | 50 |
| **Fish oil** | | |
| Yes | 15 | 15 |
| No | 35 | 35 |
| **Caffeine** | | |
| Yes | 2 | 2 |
| No | 48 | 48 |
| **Beta alanine** | | |

| | | |
|---|---|---|
| Yes | 1 | 1 |
| No | 49 | 49 |

On studying the Consumption of supplements among the Sports subjects, it was seen that 4% and 18% had consumed Creatine and Protein respectively. Further on, it was found that 26% of the sports subjects took vitamins and minerals and 10% had utilized probiotic. None consumed glucosamine supplements.

**Table 13 : Menstrual History of the study subjects**

| **Criteria** | **Frequency** | **Percentage** |
|---|---|---|
| **Age of menarche** | | |
| 9 | 2 | 2 |
| 10 | 6 | 6 |
| 11 | 7 | 7 |
| 12 | 30 | 30 |
| 13 | 34 | 34 |
| 14 | 16 | 16 |
| 15 | 2 | 2 |
| 16 | 3 | 3 |
| **Regularity of periods** | | |
| Yes | 76 | 76 |
| No | 24 | 24 |
| **Monitoring of menstrual cycle** | | |
| Yes | 76 | 76 |
| No | 24 | 24 |
| **Method of recording menstrual cycle** | | |
| Smart phone app | 15 | 15 |
| Electronic diary | 9 | 9 |
| Paper diary or calendar | 62 | 62 |
| None | 14 | 14 |
| **Usefulness of method for tracking menstrual cycle** | | |

| | | |
|---|---|---|
| Not useful at all | 5 | 5 |
| Somewhat useful | 23 | 23 |
| Moderately useful | 27 | 27 |
| Extremely useful | 31 | 31 |
| NA | 14 | 14 |
| **Female hygiene product used during period** | | |
| Sanitary napkin | 78 | 78 |
| Menstrual cups | 20 | 20 |
| Tampons | 1 | 1 |
| Cloth | 1 | 1 |
| **Number of menstrual cycles per year** | | |
| 0 - 4 | 13 | 13 |
| 5 - 8 | 15 | 15 |
| 8 - 12 | 72 | 72 |
| **No: of cycles missed in a year** | | |
| None | 56 | 56 |
| 1 | 15 | 15 |
| 2 - 4 | 24 | 24 |
| 5 - 8 | 4 | 4 |
| 8 - 12 | 1 | 1 |
| **Heaviness of menstrual flow** | | |
| Heavy – 5 pads/day | 10 | 10 |
| Medium – 3 pads/day | 63 | 63 |
| Light – 2 pads/ day | 27 | 27 |
| **Duration of menstrual cycle** | | |
| Spotting only | 3 | 3 |
| 2 days | 4 | 4 |
| 3 days | 32 | 32 |
| 5 days | 42 | 42 |
| More than 5 days | 19 | 19 |
| **No: of days in which the subject gets their period** | | |
| 28 days | 41 | 41 |

| | | |
|---|---|---|
| Lesser than 28 days | 13 | 13 |
| More than 28-35 days | 33 | 33 |
| Above 40 days | 13 | 13 |
| **Definition of pain of menstrual cycle** | | |
| Painful | 34 | 34 |
| Painless | 12 | 12 |
| Sometimes painful | 54 | 54 |

On studying the Menstrual History of the study subjects, it was seen that 76% of the participants had regular periods, 78% and 20% used sanitary napkins and menstrual cups respectively. 4% of the study population missed 8 – 12 no: of cycles an year. Further on, it was observed that 41% of study subjects got their period in 28 days and 34% found their periods painful.

**Table 14 : Gynaecological health and Contraceptive use among study subjects**

| **Criteria** | **Frequency** | **Percentage** |
|---|---|---|
| **Surgery for Gynaecological issues** | | |
| Yes | 11 | 11 |
| No | 89 | 89 |
| **Use of contraceptives** | | |
| Yes | 2 | 2 |
| No | 93 | 93 |
| Sometimes | 5 | 5 |

On studying study, the gynaecological health and contraceptive use among the study subjects, out of the 100 participants, 11 individuals (11%) had undergone surgery for gynaecological issues, while the majority of 89 participants (89%) had not undergone any gynaecological surgery. In terms of contraceptive use, only 2 participants (2%) reported using contraceptives consistently, while the vast majority of 93 participants (93%) stated that they did not use any form of contraception. Additionally, 5 participants (5%) reported using contraceptives occasionally or inconsistently.

**Table 15: Severity of Pain and use of pain relief medication among study subjects**

| Criteria | Frequency | Percentage |
|---|---|---|
| **Severity of period pain** | | |
| 1 | 6 | 6 |
| 2 | 9 | 9 |
| 3 | 10 | 10 |
| 4 | 5 | 5 |
| 5 | 7 | 7 |
| 6 | 11 | 11 |
| 7 | 12 | 12 |
| 8 | 24 | 24 |
| 9 | 9 | 9 |
| 10 | 7 | 7 |
| **Consumption of pain relief medication** | | |
| Yes | 23 | 23 |
| No | 58 | 58 |
| Sometimes | 19 | 19 |

The study examined the severity of period pain and the use of pain relief medication among the study subjects. The data revealed a range of pain severity, with participants reporting scores from 1 to 10. Six percent of participants experienced mild pain (rating 1), while 11% reported severe pain (rating 10). The majority fell into the moderate-to-high range, with 24% reporting an 8 and 12% reporting a 7 on the pain scale. In terms of pain relief medication, 23% of participants reported using it, while the majority (58%) did not use any pain relief medication. Another 19% reported using pain relief medication on an occasional basis. These findings indicate that a considerable number of participants experience moderate to severe period pain,

but a significant portion do not consistently use pain relief medication to manage their symptoms.

**Table 16: Food cravings of the study subject**

| Criteria | Frequency | Percentage |
|---|---|---|
| **Food cravings** | | |
| Yes | 51 | 51 |
| No | 49 | 49 |
| **Cravings for particular foods** | | |
| Anything sweet, spicy, and sour | 1 | 1 |
| Biriyani, chocolate | 2 | 2 |
| Burger, porotta beef | 1 | 1 |
| Burger, sour Items | 1 | 1 |
| Chicken, meat items | 2 | 2 |
| Chocolate items | 12 | 12 |
| Desserts | 2 | 2 |
| Fast foods | 3 | 3 |
| Ice-cream | 5 | 5 |
| Lays( potato chips) | 4 | 4 |
| Spicy foods | 10 | 10 |
| Sweets and fried foods | 8 | 8 |
| NIL | 49 | 49 |

The study examined the food cravings of the study subjects, and the data revealed that 51% of participants experienced food cravings, while the remaining 49% did not. Among those who had cravings, there were various specific food preferences reported. The most common craving was for chocolate items, with 12% of participants desiring them. Spicy foods were also popular,

with 10% of participants craving them. Additionally, 8% of participants had cravings for sweets and fried foods, while 5% desired ice cream. Other specific cravings included burger, chicken and meat items, desserts, fast foods, Lays (potato chips), and anything sweet, spicy, and sour.

**Table 17 : Problems faced by study subjects during menstruation**

| Criteria | Frequency | Percentage |
|---|---|---|
| **Pass large blood clots** | | |
| Yes | 12 | 12 |
| No | 88 | 88 |
| **Flood through clothes/Protection** | | |
| Yes | 4 | 4 |
| No | 96 | 96 |
| **Feel the need to frequently change sanitary napkins** | | |
| Yes | 5 | 5 |
| No | 95 | 95 |
| **Needing to wear double sanitary protection** | | |
| Yes | 3 | 3 |
| No | 97 | 97 |
| **Struggle to complete training session without changing protection** | | |
| Yes | 5 | 5 |
| No | 95 | 95 |

Among the participants, 12% reported passing large blood clots during their menstrual cycle. Additionally, 4% experienced issues with flooding through their clothes or protection, while 5% felt the need to frequently change sanitary napkins. Furthermore, 3% of participants needed to wear double sanitary protection, and 5% struggled to complete a training session without changing their protection. These findings indicate that a portion of the study subjects encountered challenges and discomfort during menstruation. The experiences of passing large blood clots, leakage or flooding, frequent changing of sanitary napkins, the need for double

protection, and interruptions during physical activities highlight the potential impact on individuals' daily lives and well-being.

**Table 18 : Abnormal health conditions faced by study subjects during menstruation**

| Criteria | Frequency | Percentage |
|---|---|---|
| **Unwanted hair - growth on face, abdomen, thighs** | | |
| Yes | 20 | 20 |
| No | 80 | 80 |
| **Milky discharge from breasts** | | |
| Yes | 3 | 3 |
| No | 97 | 97 |
| **Acne** | | |
| Yes | 38 | 38 |
| No | 62 | 62 |

On studying the abnormal health conditions faced by the study subjects during menstruation, the data revealed that among the participants, 20% reported experiencing unwanted hair growth on areas such as the face, abdomen, or thighs. Additionally, only 3% of participants reported milky discharge from their breasts during menstruation. Acne, however, was more prevalent, affecting 38% of participants. It is important to note that the majority of participants did not experience these specific abnormal health conditions. The presence of unwanted hair growth, milky discharge, and acne during menstruation can have various impacts on individuals, including aesthetic concerns and potential underlying health issues.

**Table 19: Quality of Healthy Eating Index among the study subjects**

| Criteria | Frequency | Percentage |
|---|---|---|
| Poor | 16 | 16 |
| Fair | 40 | 40 |
| Good | 44 | 44 |

The Healthy Eating Index (HEI) was used to assess the dietary habits of the study subjects, and among the participants, 44% had a good HEI, indicating that their dietary choices aligned well

with recommended healthy eating guidelines. Another 40% of participants fell into the fair HEI category, suggesting room for improvement in their dietary habits. On the other hand, 16% of participants had a poor HEI, indicating that their dietary patterns did not meet the recommended guidelines for a healthy diet. These findings emphasize the importance of ongoing education and interventions to promote healthier eating habits, particularly among individuals with a fair or poor HEI.

**Table 20 : Percent calories of nutrients among study subjects**

| Criteria | Frequency | Percentage |
|---|---|---|
| **Carbohydrates** | | |
| <= 50.00 | 28 | 28 |
| 50.01 - 60.00 | 41 | 41 |
| 60.01+ | 31 | 31 |
| **Protein** | | |
| <= 10.00 | 3 | 3 |
| 10.01 - 15.00 | 65 | 65 |
| 15.01+ | 32 | 32 |
| **Fat** | | |
| <= 25.00 | 35 | 35 |
| 25.01 - 35.00 | 48 | 48 |
| 35.01+ | 17 | 17 |

On studying the percentage of calories derived from different nutrients among the study subjects, In terms of carbohydrates, the data showed that 41% of participants fell within the range of 50.01% to 60.00% of their total calories. Another 31% had a higher carbohydrate intake, exceeding 60.01% of their calorie intake. When it comes to protein, the majority of participants (65%) obtained 10.01% to 15.00% of their calories from protein sources. For fat intake, the largest group (48%) had a range of 25.01% to 35.00% of their calories from fat.

These findings offer valuable information about the nutrient distribution in the study subject's diets. It is important to consider individual dietary preferences and cultural factors that may influence these percentages.

**Table 21 : Nutritional Adequacy Ratio (NAR) of nutrients among study subjects**

| Criteria | Frequency | Percentage |
|---|---|---|
| **Energy** | | |
| <= 50.00 | 45 | 45 |
| 50.01 - 75.00 | 36 | 36 |
| 75.01 - 100.00 | 17 | 17 |
| 100.01+ | 2 | 2 |
| **Protein** | | |
| 50.01 - 75.00 | 11 | 11 |
| 75.01 - 100.00 | 26 | 26 |
| 100.01+ | 63 | 63 |
| **Calcium** | | |
| <= 50.00 | 79 | 79 |
| 50.01 - 75.00 | 16 | 16 |
| 75.01 - 100.00 | 4 | 4 |
| 100.01+ | 1 | 1 |
| **Iron** | | |
| <= 50.00 | 52 | 52 |
| 50.01 - 75.00 | 35 | 35 |
| 75.01 - 100.00 | 9 | 9 |

| | | |
|---|---|---|
| 100.01+ | 4 | 4 |

On studying the Nutritional Adequacy Ratio (NAR) of nutrients among the study subjects, nutritional intake was assessed. In terms of energy, 45% of participants had an NAR of <=50.00%, suggesting potential inadequacy in their energy intake. For protein, a significant majority (63%) had an NAR greater than 100.01%, indicating that their protein intake exceeded the recommended levels. However, concerning calcium, 79% of participants had an NAR of <= 50.00%, suggesting potential insufficiency in their calcium intake. Similarly, more than half (52%) of participants had an NAR of <= 50.00% for iron, suggesting potential inadequacy in iron intake.These findings highlight the variability in the NAR of nutrients among the study subjects, with potential deficiencies and imbalances in certain nutrients.

**Table 22 : Type of diet between Athletes and non-athletes**

| **Criteria** | **Athletes (n=50)** | | **Non-athletes (n=50)** | | **Total (n=100)** | | **χ2 value** | **P value** |
|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | | |
| Vegetarian | 2 | 4 | 0 | 0 | 2 | 2 | 9.045 | 0.029* |
| Non-vegetarian | 45 | 90 | 43 | 86 | 88 | 88 | | |
| Lacto-vegetarian | 3 | 6 | 1 | 2 | 4 | 4 | | |
| Ovo-vegetarian | 0 | 0 | 6 | 12 | 6 | 6 | | |

*shows Significance

From 100 participants, 2 were vegetarians, 88 were non-vegetarians, 4 were lacto-vegetarians and 6 were ovo-vegetarians. There was a significant difference in food habits between athletes and non-athletes ($p<0.05$). There were no ovo-vegetarians in the athletes group whereas there were more non-vegetarian in the athletes group. No non-athletes were vegetarians.

**Table 23: Comparison of BMI among Athletes and non-athletes**

| **Categories** | **Athletes (n=50)** | **Non-athletes (n=50)** | **Total (n=100)** | **χ2 value** | **P value** |
|---|---|---|---|---|---|

| | N | % | N | % | N | % | | |
|---|---|---|---|---|---|---|---|---|
| Underweight <18.5 | 16 | 32 | 7 | 14 | 23 | 23 | 5.664 | 0.129 |
| Normal 18.5 – 22.9 | 21 | 42 | 27 | 54 | 48 | 48 | | |
| Overweight 23 – 24.9 | 4 | 8 | 8 | 16 | 12 | 12 | | |
| Obese > 25 | 9 | 18 | 8 | 16 | 17 | 17 | | |

From the 100 participants, 23 were underweight, 48 were of Normal BMI, 12 were overweight and 17 were obese. Even though there wasn't a significant difference in the BMI of athletes and non-athletes, more number of non-athletes were underweight compared to athletes.

**Table 24: Prevalence of Anaemia among Athletes and non-athletes**

| **Criteria** | **Athletes (n=50)** | | **Non-athletes (n=50)** | | **Total (n=100)** | | **$\chi 2$ value** | **P value** |
|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | | |
| Anaemic | 16 | 32 | 18 | 36 | 34 | 34 | 0.178 | 0.673 |
| Non-Anaemic | 34 | 68 | 32 | 64 | 66 | 66 | | |

From the 100 participants, 34 were Anaemic and 66 were non-anaemic. More number of non-athletes were Anaemic compared to Athletes, even though there was no significant difference between the same. To determine if there was a significant difference in the prevalence of anaemia between athletes and non-athletes, a chi-square test was performed. The calculated chi-square value was 0.178, with a corresponding p-value of 0.673. Since the p-value is greater than 0.05 (commonly used significance level), there is no significant association between being an athlete or non-athlete and the likelihood of having anaemia.

These findings suggest that there is no substantial difference in the prevalence of anaemia between athletes and non-athletes.

**Table 25: Use of Iron injection or supplementation among Athletes and non-athletes**

| Criteria | Athletes (n=50) | | Non-athletes (n=50) | | Total (n=100) | | χ2 value | P value |
|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | | |
| Uses iron Supplements | 17 | 34 | 18 | 36 | 35 | 35 | 0.044 | 0.834 |
| Doesn't use iron supplements | 33 | 66 | 32 | 64 | 65 | 65 | | |

From the 100 participants, 35 have Utilized Iron Supplements or injection and the remaining 65 have not used iron supplements. Slightly higher percentage of athletes takes iron supplements compared to non-athletes, even though there was no significant difference between the same.

**Table 26: Diagnosis of various Health conditions among athletes and non-athletes**

| Criteria | Athletes (n=50) | | Non-athletes (n=50) | | Total (n=100) | | χ2 value | P value |
|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | | |
| Stress fracture | 6 | 12 | 0 | 0 | 6 | 6 | 6.383 | 0.012* |
| Eating disorder | 11 | 22 | 5 | 10 | 16 | 16 | 2.679 | 0.102 |
| Low bone density | 6 | 12 | 4 | 8 | 10 | 10 | 0.44 | 0.50 |
| Asthma | 6 | 12 | 4 | 8 | 10 | 10 | 0.44 | 0.50 |
| Oligo/ amenorrhoea | 5 | 10 | 10 | 20 | 15 | 15 | 1.96 | 0.16 |
| ACL rupture | 4 | 8 | 0 | 0 | 4 | 4 | 4.16 | 0.04* |
| Haemochromatosis | 1 | 2 | 0 | 0 | 1 | 1 | 1.01 | 0.31 |
| Depression/Anxiety | 11 | 22 | 3 | 6 | 14 | 14 | 5.31 | 0.02* |
| Hypothyroidism | 1 | 2 | 5 | 10 | 6 | 6 | 2.83 | 0.09 |

*shows significance

Even though not significant, Higher percentage of athletes had eating disorder as compared to non-athletes.

Significantly higher percentage of athletes had stress fractures and ACL Rupture as compared to non-athletes ($p<0.05$). Depression and Anxiety was seen significantly higher in Athletes than non-athletes although Hypothyroidism was seen more in non-athletes.

**Table 27: Regularity of periods among athletes and non-athletes**

| **Criteria** | **Athletes (n=50)** | | **Non-athletes (n=50)** | | **Total (n=100)** | | **χ2 value** | **P value** |
|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | | |
| Regular period | 40 | 80 | 36 | 72 | 76 | 76 | 0.877 | 0.349 |
| Irregular period | 10 | 20 | 14 | 28 | 24 | 24 | | |

From the 100 participants, Higher number of participants (76) had regular periods compared to the remaining 24 who had irregular periods. Athletes had regular periods than non-athletes even though there is no significant difference.

To determine if there was a significant difference in the regularity of periods between athletes and non-athletes, a chi-square test was performed. The calculated chi-square value was 0.877, with a corresponding p-value of 0.349. Since the p-value is greater than 0.05 (commonly used significance level), there is no significant association between being an athlete or non-athlete and the regularity of periods.

These findings suggest that there is no substantial difference in the regularity of periods between athletes and non-athletes. Both groups had similar proportions of individuals who reported having regular periods and those who reported having irregular periods. However, it is worth noting that a slightly higher percentage of athletes reported having regular periods compared to non-athletes.

**Table 28: Tracking Menstrual cycle among athletes and non-athletes**

| **Criteria** | **Athletes (n=50)** | | **Non-athletes (n=50)** | | **Total (n=100)** | | **χ2 value** | **P value** |
|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | | |
| Tracks menstrual cycle | 37 | 74 | 39 | 78 | 76 | 76 | 0.219 | 0.640 |
| Doesn't track Menstrual cycle | 13 | 26 | 11 | 22 | 24 | 24 | | |

From the 100 participants, majority of them tracked their menstrual cycle. Although, higher number of non-athletes tracked their menstrual cycle compared to Athletes.

**Table 29: Method of recording Menstrual cycle among athletes and non-athletes**

| **Criteria** | **Athletes (n=50)** | | **Non-athletes (n=50)** | | **Total (n=100)** | | **χ2 value** | **P value** |
|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | | |
| Smart phone | 15 | 30 | 0 | 0 | 15 | 15 | 35.87 | 0.000* |
| Electronic diary | 2 | 4 | 7 | 14 | 9 | 9 | | |
| Paper diary/ calendar | 20 | 40 | 42 | 84 | 62 | 62 | | |
| None | 13 | 26 | 1 | 2 | 14 | 14 | | |

*shows significance

From 100 participants, 15 used smart phones and 9 used electronic diary to record menstrual cycle, whereas 62 of them used paper diary/ calendar for the same. There was a significant difference in tracking of menstrual cycle between athletes and non-athletes ($p<0.05$). More number of Athletes did not track their menstrual cycle compared to non-athletes.

**Table 30: Usefulness of the method of tracking menstrual cycle among athletes and non-athletes**

| **Criteria** | **Athletes (n=50)** | | **Non-athletes (n=50)** | | **Total (n=100)** | | **χ2 value** | **P value** |
|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | | |
| NA | 13 | 26 | 1 | 2 | 14 | 14 | 24.250 | 0.000* |
| Not useful at all | 1 | 2 | 4 | 8 | 5 | 5 | | |
| Somewhat useful | 17 | 34 | 6 | 12 | 23 | 23 | | |
| Moderately useful | 9 | 18 | 18 | 36 | 27 | 27 | | |
| Extremely useful | 10 | 20 | 21 | 42 | 31 | 31 | | |

*shows significance

Out of the 100 participants, 31 of the participants found their mode of tracking menstrual cycle extremely useful, 27 of them found it moderately useful and 5 of them did not find it useful at all. There was a significant difference in tracking of menstrual cycle between athletes and non-athletes ($p<0.05$).

**Table 31: Female hygiene product used during periods among athletes and non-athletes**

| **Criteria** | **Athletes (n=50)** | | **Non-athletes (n=50)** | | **Total (n=100)** | | **χ2 value** | **P value** |
|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | | |
| Sanitary napkin | 40 | 80 | 38 | 76 | 78 | 78 | 2.851 | 0.415 |
| Menstrual cups | 8 | 16 | 12 | 24 | 20 | 20 | | |
| Tampons | 1 | 2 | 0 | 0 | 1 | 1 | | |
| Cloth | 50 | 100 | 50 | 100 | 100 | 100 | | |

From 100 participants, 78 used sanitary napkin, 50 used cloth, 20 used menstrual cups, and 1 used tampon and even though there was not a significant difference in female hygiene products used between athletes and non-athletes ($p<0.05$). There were no tampon users in the non-athletes group whereas there were more menstrual cup users in the non-athletes group. Equal number of athletes and non-athletes used cloth.

**Table 32: Number of menstrual cycles per year among athletes and non-athletes**

| **Criteria** | **Athletes (n=50)** | | **Non-athletes (n=50)** | | **Total (n=100)** | | **χ2 value** | **P value** |
|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | | |
| 0 - 4 | 9 | 18 | 4 | 8 | 13 | 13 | 2.212 | 0.331 |
| 5 - 8 | 7 | 14 | 8 | 16 | 15 | 15 | | |
| 8 - 12 | 34 | 68 | 38 | 76 | 72 | 72 | | |

From the 100 participants, 72 had 8 to 12 menstrual cycles an year, 15 had 5 to 8 cycles and 13 had 0 to 4 cycles per year. Even though not significant, Higher percentage of athletes had 0 to 4 menstrual cycles per year as compared to non-athletes. The calculated chi-square value

was 2.212, with a corresponding p-value of 0.331. Since the p-value is greater than 0.05 (commonly used significance level), there is no significant association between being an athlete or non-athlete and the number of menstrual cycles per year.

These findings suggest that there is no substantial difference in the number of menstrual cycles per year between athletes and non-athletes. Both groups had similar proportions of individuals who reported having 0-4, 5-8, or 8-12 menstrual cycles per year.

**Table 33: Number of missed menstrual cycles per year among athletes and non-athletes**

| **Criteria** | **Athletes (n=50)** | | **Non-athletes (n=50)** | | **Total (n=100)** | | **χ2 value** | **P value** |
|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | | |
| 1 | 30 | 60 | 26 | 52 | 56 | 56 | 1.519 | 0.823 |
| 2 - 4 | 7 | 14 | 8 | 16 | 15 | 15 | | |
| 5 - 8 | 2 | 4 | 2 | 4 | 4 | 4 | | |
| 8 - 12 | 0 | 0 | 1 | 2 | 1 | 1 | | |

From the 100 participants, 56 had missed one menstrual cycle per year, 15 had missed 2 to 4 cycles and 4 had missed 5 to 8 cycles per year. Even though not significant, Higher percentage of athletes had missed 1 cycle in an year as compared to non-athletes.

**Table 34: Heaviness of Menstrual flow among athletes and non-athletes**

| **Criteria** | **Athletes (n=50)** | | **Non-athletes (n=50)** | | **Total (n=100)** | | **χ2 value** | **P value** |
|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | | |
| Heavy | 6 | 12 | 4 | 8 | 10 | 10 | 1.469 | 0.480 |
| Medium | 33 | 66 | 30 | 60 | 63 | 63 | | |
| Light | 11 | 22 | 16 | 32 | 27 | 27 | | |

Out of the 100 participants, 63 of the participants had medium menstrual flow , 27 of them had light menstrual flow and 10 had Heavy menstrual flow. Even though not significant, Higher percentage of non-athletes had light menstrual flow as compared to athletes.

**Table 35: Length of period among athletes and non-athletes**

| Criteria | Athletes (n=50) | | Non-athletes (n=50) | | Total (n=100) | | χ2 value | P value |
|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | | |
| Spotting only | 1 | 2 | 2 | 4 | 3 | 3 | 2.932 | 0.569 |
| 2 days | 1 | 2 | 3 | 6 | 4 | 4 | | |
| 3 days | 19 | 38 | 13 | 26 | 32 | 32 | | |
| 5 days | 21 | 42 | 21 | 42 | 42 | 42 | | |
| More than 5 days | 8 | 16 | 11 | 22 | 19 | 19 | | |

Out of the 100 participants, 42 of them had menstrual flow for 5 days, 32 of them had menstrual flow for 3 days and 19 had menstrual flow for more than 5 days. Even though not significant, Higher percentage of non-athletes had spotting as compared to athletes.

**Table 36: Number of days in which one gets their period among athletes and non-athletes**

| Criteria | Athletes (n=50) | | Non-athletes (n=50) | | Total (n=100) | | χ2 value | P value |
|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | | |
| 28 days | 24 | 48 | 17 | 34 | 41 | 41 | 3.225 | 0.358 |
| <28 days | 6 | 12 | 7 | 14 | 13 | 13 | | |
| 28 – 35 days | 16 | 32 | 17 | 34 | 33 | 33 | | |
| Above 40 days | 4 | 8 | 9 | 18 | 13 | 13 | | |

From the 100 participants, 41 got their period in 28 days, 33 got their period in 28-35 days and 13 got their period in less than 28 days as well as above 40 days. Even though not significant, Higher percentage of athletes got their period in 28 days as compared to non-athletes.

**Table 37: Pain Intensity of Menstrual cycle among athletes and non-athletes**

| Criteria | Athletes (n=50) | | Non-athletes (n=50) | | Total (n=100) | | χ2 value | P value |
|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | | |
| Painful | 16 | 32 | 18 | 36 | 34 | 34 | 0.192 | 0.909 |
| Painless | 6 | 12 | 6 | 12 | 12 | 12 | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sometimes painful | 28 | 56 | 26 | 52 | 54 | 54 | | |

From the 100 participants, 54 found their period sometimes painful, 34 found theirs painful and 12 had painless periods. Even though not significant, Higher percentage of non-athletes got painful period as compared to athletes.

**Table 38: Gynaecological or women's Health related surgery among athletes and non-athletes**

| **Criteria** | **Athletes (n=50)** | | **Non-athletes (n=50)** | | **Total (n=100)** | | **χ2 value** | **P value** |
|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | | |
| Have done surgery | 5 | 10 | 6 | 12 | 11 | 11 | 0.102 | 0.749 |
| Have not done surgery | 45 | 90 | 44 | 88 | 89 | 89 | | |

To determine if there was a significant difference in the occurrence of surgery between athletes and non-athletes, a chi-square test was performed. The calculated chi-square value was 0.102, with a corresponding p-value of 0.749. Since the p-value is greater than 0.05 (commonly used significance level), there is no significant association between being an athlete or non-athlete and the likelihood of undergoing gynaecological or women's health-related surgery.

These findings suggest that there is no substantial difference in the occurrence of surgery for gynaecological or women's health issues between athletes and non-athletes. Both groups had similar proportions of individuals who had undergone surgery and those who had not.

**Table 39: Use of contraceptives among athletes and non-athletes**

| **Criteria** | **Athletes (n=50)** | | **Non-athletes (n=50)** | | **Total (n=100)** | | **χ2 value** | **P value** |
|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | | |
| Yes | 0 | 0 | 2 | 4 | 2 | 2 | 2.297 | 0.317 |
| No | 48 | 96 | 45 | 90 | 93 | 93 | | |
| Sometimes | 2 | 4 | 3 | 6 | 5 | 5 | | |

Out of the 100 participants, 2 had used contraceptive pills and even though there was not a significant difference, a higher percentage of non-athletes had used contraceptives sometimes as compared to athletes.

**Table 40: Use of Pain medication among athletes and non-athletes**

| | **Athletes (n=50)** | | **Non-athletes (n=50)** | | **Total (n=100)** | | **χ2 value** | **P value** |
|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | | |
| Yes | 13 | 26 | 10 | 20 | 23 | 23 | 1.486 | 0.476 |
| No | 26 | 52 | 32 | 64 | 58 | 58 | | |
| Sometimes | 11 | 22 | 8 | 16 | 19 | 19 | | |

Among the 100 participants, 23 had consumed pain medication whereas, 19 of them used it sometimes. Even though a significant difference cannot be seen, 64% of non-athletes does not use medications to reduce pain as compared to 52% of athletes.

**Table 41: Craving for particular foods during the menstrual cycle among athletes and non-athletes**

| **Criteria** | **Athletes (n=50)** | | **Non-athletes (n=50)** | | **Total (n=100)** | | **χ2 value** | **P value** |
|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | | |
| Yes | 26 | 52 | 25 | 50 | 51 | 51 | 0.040 | 0.841 |
| No | 24 | 48 | 25 | 50 | 49 | 49 | | |

Out of the 100 participants, 51% of the population reported cravings for particular foods during the menstrual cycle. These included desserts, chocolates and fast food items. Higher percentage (52%) of athletes reported cravings compared to non-athletes without any significant difference.

**Table 42: Problems faced during periods among athletes and non-athletes**

| Criteria | Athletes (n=50) | | Non-athletes (n=50) | | Total (n=100) | | χ2 value | P value |
|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | | |
| Pass large blood clots | 12 | 24 | 0 | 0 | 12 | 12 | 13.636 | 0.000* |
| Flood through protection to clothes | 4 | 8 | 0 | 0 | 4 | 4 | 4.167 | 0.041* |
| Needing to frequently change pads | 5 | 10 | 0 | 0 | 5 | 5 | 5.263 | 0.022* |
| Needing to wear double sanitary protection | 3 | 6 | 0 | 0 | 3 | 3 | 3.093 | 0.079 |
| Struggle to complete training session without changing protection | 5 | 10 | 0 | 0 | 5 | 5 | 5.263 | 0.022* |

*shows significance

There was a significant difference in the problems faced between athletes and non-athletes ($p<0.05$) during menstrual cycle. 24% of the athletes passed large blood clots, 10% of the athletes struggled to complete their training session without changing protection and 6% felt the need to wear double sanitary protection during their period. No non-athletes faced these problems during their period.

**Table 43: Health conditions during period among athletes and non-athletes**

| Criteria | Athletes (n=50) | | Non-athletes (n=50) | | Total (n=100) | | χ2 value | P value |
|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | | |
| PCOD | 1 | 2 | 0 | 0 | 1 | 1 | 6.086 | 0.298 |
| Early menopause | 6 | 12 | 9 | 18 | 15 | 15 | | |
| Excess hormone prolactin | 1 | 2 | 0 | 0 | 1 | 1 | | |
| Endometriosis | 0 | 0 | 1 | 2 | 1 | 1 | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Irregular ovulation | 2 | 4 | 6 | 12 | 8 | 8 | | |
| None of the above | 40 | 80 | 34 | 68 | 74 | 74 | | |

The study compared the prevalence of various health conditions during the menstrual period between athletes and non-athletes. The findings showed that among athletes, a small percentage reported having polycystic ovary syndrome (PCOS), early menopause, excess hormone prolactin, and irregular ovulation. Among non-athletes, a similar pattern was observed, with a slightly higher percentage reporting early menopause and irregular ovulation. However, there were no significant differences between the two groups in terms of the prevalence of these health conditions. The results suggest that being an athlete or non-athlete does not significantly impact the occurrence of these conditions during the menstrual period.

**Table 44: Abnormal health conditions related to Menstrual cycle among athletes and non-athletes**

| **Criteria** | **Athletes (n=50)** | | **Non-athletes (n=50)** | | **Total (n=100)** | | **$\chi 2$ value** | **P value** |
|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | | |
| Unwanted hair | 7 | 14 | 13 | 26 | 20 | 20 | 2.250 | 0.134 |
| Milk discharge | 3 | 6 | 0 | 0 | 3 | 3 | 3.093 | 0.079 |
| Acne | 14 | 28 | 24 | 48 | 38 | 38 | 4.244 | 0.039* |

*shows significance

The study aimed to assess the occurrence of abnormal health conditions related to the menstrual cycle among athletes and non-athletes. Among athletes, 14% reported unwanted hair growth, 6% experienced milk discharge from the breasts, and 28% had acne. In comparison, among non-athletes, a higher percentage (26%) reported unwanted hair growth, while none reported milk discharge. However, a slightly lower percentage (48%) experienced acne. Statistical analysis indicated a significant difference in the occurrence of acne between athletes and non-athletes, with athletes having a higher prevalence. These findings suggest that athletes may be more prone to acne during the menstrual cycle compared to non-athletes.

**Table 45: Quality of HEI among athletes and non-athletes**

| Criteria | Athletes (n=50) | | Non-athletes (n=50) | | Total (n=100) | | χ2 value | P value |
|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | | |
| Poor | 9 | 18 | 7 | 14 | 16 | 16 | 0.741 | 0.690 |
| Fair | 18 | 36 | 22 | 44 | 40 | 40 | | |
| Good | 23 | 46 | 21 | 42 | 44 | 44 | | |

The table presents the quality of Healthy Eating Index (HEI) among athletes and non-athletes. The participant's HEI was categorized into three groups: poor, fair, and good. Among athletes, 18% had a poor HEI, 36% had a fair HEI, and 46% had a good HEI. In comparison, among non-athletes, 14% had a poor HEI, 44% had a fair HEI, and 42% had a good HEI. Statistical analysis indicated no significant difference in the quality of HEI between athletes and non-athletes. These findings suggest that both athletes and non-athletes have similar levels of adherence to a healthy eating index. However, it's important to note that a considerable proportion of both groups fell into the fair category, indicating room for improvement in their dietary habits.

**Table 46: Percentage energy of Carbohydrates among athletes & non-athletes**

| Criteria | Athletes (n=50) | | Non-athletes (n=50) | | Total (n=100) | | χ2 value | P value |
|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | | |
| <=50.00 | 14 | 28 | 14 | 28 | 28 | 28 | 2.776 | 0.250 |
| 50.01-60.00 | 24 | 48 | 17 | 34 | 41 | 41 | | |
| 60.01+ | 12 | 24 | 19 | 38 | 31 | 31 | | |

Table 40 compares the percentage of energy from carbohydrates among athletes and non-athletes. The participant's carbohydrate intake was divided into three categories: <=50.00%, 50.01-60.00%, and 60.01% or higher. Among athletes, 28% consumed <=50.00% of their energy from carbohydrates, 48% consumed 50.01-60.00%, and 24% consumed 60.01% or higher. In comparison, among non-athletes, 28% consumed <=50.00% of their energy from carbohydrates, 34% consumed 50.01-60.00%, and 38% consumed 60.01% or higher. Statistical analysis revealed no significant difference in the percentage of energy from carbohydrates between athletes and non-athletes. These findings suggest that both groups had similar patterns

of carbohydrate consumption in terms of energy contribution. It's worth noting that a significant proportion of participants in both groups consumed carbohydrates within the recommended range.

**Table 47: Percentage energy of protein among athletes & non-athletes**

| Criteria | Athletes (n=50) | | Non-athletes (n=50) | | Total (n=100) | | χ2 value | P value |
|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | | |
| <=10.00 | 3 | 6 | 0 | 0 | 3 | 3 | 2 | 0.208 |
| 10.01-15.00 | 31 | 62 | 34 | 68 | 65 | 65 | | |
| 15.01 | 16 | 32 | 16 | 32 | 32 | 32 | | |

Table 41 presents the percentage of energy from protein among athletes and non-athletes. The data includes 50 athletes and 50 non-athletes, resulting in a total of 100 participants. The participants' protein intake was divided into three categories: <=10.00%, 10.01-15.00%, and 15.01% or higher. Among athletes, 6% consumed <=10.00% of their energy from protein, 62% consumed 10.01-15.00%, and 32% consumed 15.01% or higher. Comparatively, among non-athletes, none consumed <=10.00% of their energy from protein, 68% consumed 10.01-15.00%, and 32% consumed 15.01% or higher. Statistical analysis revealed no significant difference in the percentage of energy from protein between athletes and non-athletes. These findings indicate that both groups had similar patterns of protein consumption in terms of energy contribution.

**Table 48: Percentage energy of fat among athletes & non-athletes**

| Criteria | Athletes (n=50) | | Non-athletes (n=50) | | Total (n=100) | | χ2 value | P value |
|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | | |
| <=25.00 | 12 | 24 | 23 | 46 | 35 | 35 | 10.575 | 0.005* |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 25.01-35.00 | 24 | 48 | 24 | 48 | 48 | 48 | | |
| 35.01 | 14 | 28 | 3 | 6 | 17 | 17 | | |

*shows significance

Table 42 displays the percentage of energy from fat among athletes and non-athletes. The participants' fat intake was categorized into three groups: <=25.00%, 25.01-35.00%, and 35.01% or higher. Among athletes, 24% consumed <=25.00% of their energy from fat, 48% consumed 25.01-35.00%, and 28% consumed 35.01% or higher. Comparatively, among non-athletes, 46% consumed <=25.00% of their energy from fat, 48% consumed 25.01-35.00%, and 6% consumed 35.01% or higher. Statistical analysis revealed a significant difference in the percentage of energy from fat between athletes and non-athletes (p=0.005). These findings suggest that non-athletes had a higher proportion of individuals consuming lower levels of fat compared to athletes.

**Table 49: NAR of Energy among athletes & non-athletes**

| **Criteria** | **Athletes (n=50)** | | **Non-athletes (n=50)** | | **Total (n=100)** | | **χ2 value** | **P value** |
|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | | |
| <=50.00 | 40 | 80 | 5 | 10 | 45 | 45 | 51.458 | 0.000* |
| 50.01-75.00 | 9 | 18 | 27 | 54 | 36 | 36 | | |
| 75.01-100.00 | 1 | 2 | 16 | 32 | 17 | 17 | | |
| 100.01 | 0 | 0 | 2 | 4 | 2 | 2 | | |

*shows significance

Table 43 presents the Nutritional Adequacy Ratio (NAR) of Energy among athletes and non-athletes. The NAR of Energy is categorized into four groups: <=50.00%, 50.01-75.00%, 75.01-100.00%, and 100.01%. Among athletes, 80% achieved a NAR of Energy <=50.00%, 18% achieved 50.01-75.00%, and 2% achieved 75.01-100.00%. None of the athletes achieved a NAR of Energy at 100.01%. In comparison, among non-athletes, 10% achieved a NAR of Energy <=50.00%, 54% achieved 50.01-75.00%, 32% achieved 75.01-100.00%, and 4% achieved 100.01%. Statistical analysis revealed a significant difference in the NAR of Energy between athletes and non-athletes (p=0.000). These findings indicate that non-athletes had a higher proportion of individuals achieving higher levels of nutritional adequacy for energy compared to athletes.

**Table 50: NAR of protein among athletes & non-athletes**

| Criteria | Athletes (n=50) | | Non-athletes (n=50) | | Total (n=100) | | χ2 value | P value |
|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | | |
| 50.01-75.00 | 6 | 12 | 5 | 10 | 11 | 11 | 1.103 | 0.576 |
| 75.01-100.00 | 15 | 30 | 11 | 22 | 26 | 26 | | |
| 100.01 | 29 | 58 | 34 | 68 | 63 | 63 | | |

The NAR of protein is divided into three categories: 50.01-75.00%, 75.01-100.00%, and 100.01%. Among athletes, 12% achieved a NAR of protein in the range of 50.01-75.00%, 30% achieved 75.01-100.00%, and 58% achieved a NAR of protein at 100.01%. In comparison, among non-athletes, 10% achieved a NAR of protein in the range of 50.01-75.00%, 22% achieved 75.01-100.00%, and 68% achieved a NAR of protein at 100.01%. Statistical analysis revealed no significant difference in the NAR of protein between athletes and non-athletes (p=0.576). These findings indicate that both athletes and non-athletes have a relatively high proportion of individuals achieving a sufficient NAR of protein.

**Table 51: NAR of calcium among athletes & non-athletes**

| Criteria | Athletes (n=50) | | Non-athletes (n=50) | | Total (n=100) | | χ2 value | P value |
|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | | |
| <=50.00 | 42 | 84 | 37 | 74 | 79 | 79 | 3.566 | 0.312 |
| 50.01-75.00 | 5 | 10 | 11 | 22 | 16 | 16 | | |
| 75.01-100.00 | 2 | 4 | 2 | 4 | 4 | 4 | | |
| 100.01+ | 1 | 2 | 0 | 0 | 1 | 1 | | |

The NAR of calcium is divided into four categories: <=50.00%, 50.01-75.00%, 75.01-100.00%, and 100.01% or higher. Among athletes, 84% achieved a NAR of calcium in the range of <=50.00%, 10% achieved 50.01-75.00%, 4% achieved 75.01-100.00%, and 2% achieved a NAR of calcium at 100.01% or higher. Among non-athletes, 74% achieved a NAR

of calcium in the range of <=50.00%, 22% achieved 50.01-75.00%, 4% achieved 75.01-100.00%, and none achieved a NAR of calcium at 100.01% or higher. Statistical analysis indicated no significant difference in the NAR of calcium between athletes and non-athletes (p=0.312). These results suggest that both athletes and non-athletes have relatively low proportions of individuals achieving a sufficient NAR of calcium.

**Table 52: NAR of iron among athletes & non-athletes**

| **Criteria** | **Athletes (n=50)** | | **Non-athletes (n=50)** | | **Total (n=100)** | | **χ2 value** | **P value** |
|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | | |
| <=50.00 | 27 | 54 | 25 | 50 | 52 | 52 | 1.105 | 0.776 |
| 50.01-75.00 | 18 | 36 | 17 | 34 | 35 | 35 | | |
| 75.01-100.00 | 3 | 6 | 6 | 12 | 9 | 9 | | |
| 100.01+ | 2 | 4 | 2 | 4 | 4 | 4 | | |

The data consists of 50 athletes and 50 non-athletes, resulting in a total of 100 participants. The NAR of iron is divided into four categories: <=50.00%, 50.01-75.00%, 75.01-100.00%, and 100.01% or higher. Among athletes, 54% had a NAR of iron within the <=50.00% range, 36% fell within the 50.01-75.00% range, 6% fell within the 75.01-100.00% range, and 4% achieved a NAR of iron at 100.01% or higher. Among non-athletes, 50% had a NAR of iron within the <=50.00% range, 34% fell within the 50.01-75.00% range, 12% fell within the 75.01-100.00% range, and 4% achieved a NAR of iron at 100.01% or higher. The chi-square test was conducted, resulting in a chi-square value of 1.105 and a p-value of 0.776, indicating no significant difference in the NAR of iron between athletes and non-athletes. These findings suggest that both athletes and non-athletes have similar proportions of individuals with inadequate NAR of iron, emphasizing the need to address iron intake in both groups to support optimal health.

**Anthropometric parameters:**

**Table 53: Anthropometric information among athletes & non-athletes**

| **Criteria** | **Athletes (n=50)** | **Non-athletes (n=50)** | **Total (n=100)** | **T value** | **P value** |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| Height (cm) | 160.7±6.2 | 157.8±6.3 | 159.2±6.4 | 2.299 | 0.024* |
| Weight (kg) | 54.8±11.1 | 53.9±7.9 | 54.4±9.6 | 0.463 | 0.644 |
| BMI (kg/m2) | 21.2±4.3 | 21.7±3.1 | 21.5±3.7 | -0.578 | 0.565 |

Data presented as Mean±SD *shows significance

For the 100 participants, the mean height was 159.2±6.4 cm, weight was 54.4±9.6 kg and BMI was 21.5±3.7 kg/m2. Athletes were significantly taller as compared to non-athletes ($p<0.05$). No significant difference observed in the weight or BMI of athletes and non-athletes ($p>0.05$). These findings suggest that while athletes may have a taller stature, their weight and body mass index are comparable to non-athletes.

**Table 54 : Biochemical data among athletes & non-athletes**

| **Criteria** | **Athletes (n=50)** | **Non-athletes (n=50)** | **Total (n=100)** | **T value** | **P value** |
|---|---|---|---|---|---|
| Hb | 12.1±1.1 | 12.1±1.3 | 12.1±1.2 | 0.033 | 0.973 |

Data presented as Mean±SD

The comparison of biochemical data between athletes and non-athletes reveals that there is no significant difference in the haemoglobin (Hb) levels. Both groups had an average Hb level of 12.1 g/dL, indicating similar levels of oxygen-carrying capacity in their blood.

**Table 55: Cravings for particular foods among athletes & non-athletes**

| **Criteria** | **Athletes (n=50)** | **Non-athletes (n=50)** | **Total (n=100)** | **T value** | **P value** |
|---|---|---|---|---|---|
| Indian sweets | 2.16±1.267 | 2.62±1.308 | 2.4±1.3 | -1.819 | 0.069 |
| Cakes and cookies | 2.58±1.458 | 3.42±1.416 | 3.0±1.5 | -2.811 | 0.005* |
| Chips | 2.7±1.344 | | 2.8±1.4 | -0.974 | 0.33 |
| Fried foods | 2.42±1.372 | 2.78±1.404 | 2.6±1.4 | -1.328 | 0.184 |
| Chaat | 2.1±1.249 | 2.12±1.319 | 2.1±1.3 | -0.066 | 0.948 |
| Instant noodles | 2.38±1.413 | 2.78±1.389 | 2.6±1.4 | -1.447 | 0.148 |

| | | | | | |
|---|---|---|---|---|---|
| Fruits and vegetables | 2.54±1.328 | 2.62±1.427 | 2.6±1.4 | -0.223 | 0.824 |
| Nuts and dry fruits | 2.6±1.414 | 2.7±1.298 | 2.7±1.4 | -0.512 | 0.608 |
| Spicy foods | 2.86±1.485 | 3.24±1.393 | 3.1±1.43 | -1.231 | 0.218 |
| Fast foods | 2.98±1.558 | 3.16±1.419 | 3.1±1.5 | -0.554 | 0.58 |
| Eggs, meat, fish products. | 2.5±1.359 | 2.72±1.325 | 2.6±1.3 | -0.886 | 0.376 |

Data presented as Mean±SD *shows significance

While there were no significant differences in cravings for Indian sweets, chips, chaat, instant noodles, fruits and vegetables, nuts and dry fruits, and eggs, meat, fish products between the two groups, there were notable differences in cravings for cakes and cookies, spicy foods, fast foods.Athletes showed significantly lower cravings for cakes and cookies compared to non-athletes, indicating a potentially healthier dietary preference among athletes. On the other hand, non-athletes reported higher cravings for cakes and cookies, suggesting a higher preference for indulgent and high-calorie foods.

**Table 56: Dietary Intake among athletes & non-athletes**

| **Criteria** | **Athletes (n=50)** | **Non-athletes (n=50)** | **Total (n=100)** | **T value** | **P value** |
|---|---|---|---|---|---|
| Energy | 1204.3±327.2 | 1170.4±270.3 | 1187.3±299.1 | 0.565 | 0.574 |
| Carbohydrate | 160.2± 56.2 | 164.1±57.3 | 162.2±56.5 | -0.342 | 0.733 |
| Protein | 41.4±12.9 | 42.6±14.1 | 42.0±13.4 | -0.443 | 0.658 |
| Fat | 40.7±14.2 | 33.2±9.6 | 37.0±12.7 | 3.1 | 0.003* |
| Calcium | 316.8±223.5 | 329.9±153.1 | 323.3±190.7 | -0.343 | 0.733 |
| Iron | 7.6 | 3.1 | 7.8±3.3 | -0.749 | 0.456 |

*shows significance

The comparison of dietary intake between athletes and non-athletes revealed some interesting patterns. Both groups had similar energy intake, indicating that they consumed a comparable number of calories. There were no significant differences in carbohydrate and protein intake, suggesting that both athletes and non-athletes had similar dietary patterns in terms of these macronutrients. However, athletes had a higher fat intake than non-athletes, which could be attributed to their specific dietary needs for energy and performance. When it comes to micronutrients, both groups had similar calcium intake, but athletes had a higher iron intake, which is important for their increased iron needs due to higher physical activity levels.

**Table 57: Quality of HEI among athletes & non-athletes**

| **Criteria** | **Athletes (n=50)** | **Non-athletes (n=50)** | **Total (n=100)** | **T value** | **P value** |
|---|---|---|---|---|---|
| HEI | 61.5±10.7 | 61.5±8.8 | 61.5±9.8 | 0.012 | 0.991 |

The comparison of the Healthy Eating Index (HEI) scores between athletes and non-athletes did not reveal any significant differences. Both groups had similar mean HEI scores of 61.5, indicating that their overall dietary quality was comparable. The T-value of 0.012 and the associated p-value of 0.991 further confirm that there were no significant discrepancies in the HEI scores between the two groups. This suggests that both athletes and non-athletes had similar adherence to recommended dietary guidelines and exhibited comparable levels of overall dietary quality. The findings indicate that the quality of the participants' diets, as measured by the HEI, did not differ significantly between athletes and non-athletes in this study.

**Table 58 : Percentage Energy Nutrient values among athletes & non-athletes**

| **Criteria** | **Athletes (n=50)** | **Non-athletes (n=50)** | **Total (n=100)** | **T value** | **P value** |
|---|---|---|---|---|---|
| Percentage Energy CHO | 52.7±9.9 | 55.5±11.0 | 54.1±10.5 | -1.347 | 0.181 |
| Percentage Energy Protein | 13.8±2.5 | 14.6±3.5 | 14.2±3.1 | -1.308 | 0.194 |

| | | | | | |
|---|---|---|---|---|---|
| Percentage Energy Fat | 31.1±9.4 | 26.1±7.2 | 28.6±8.7 | 2.993 | 0.004* |

*shows significance

There was no significant difference in the percentage of energy from carbohydrates and protein between the two groups. Athletes and non-athletes had similar proportions of energy derived from these macronutrients. However, there was a significant difference in the percentage energy from fat. Athletes had a higher percentage of energy from fat compared to non-athletes. This suggests that athletes may have different dietary preferences or requirements, possibly due to their higher energy expenditure and specific nutritional needs for athletic performance.

**Table 59 : Nutritional Adequacy Ratio (NAR) of Nutrients among athletes & non-athletes**

| **Criteria** | **Athletes (n=50)** | **Non-athletes (n=50)** | **Total (n=100)** | **T value** | **P value** |
|---|---|---|---|---|---|
| NAR Energy | 44.3±12.0 | 70.5±16.3 | 57.4±19.4 | -9.162 | 0 |
| NAR Protein | 114.9±35.8 | 118.2±39.1 | 116.6±37.3 | -0.443 | 0.658 |
| NAR calcium | 39.6±27.9 | 41.2±19.1 | 40.4±23.8 | -0.343 | 0.733 |
| NAR iron | 50.5±20.8 | 53.8±23.1 | 52.2±21.9 | -0.749 | 0.456 |

Non-athletes had a higher NAR Energy, indicating a better adequacy of energy intake relative to their energy needs compared to athletes. However, there were no significant differences in NAR Protein, NAR Calcium, and NAR Iron, suggesting that both athletes and non-athletes met their requirements for these nutrients. This implies that although non-athletes had a higher energy adequacy, both groups maintained similar levels of adequacy for protein, calcium, and iron.

**Table 60 : Comparison of the sub-scales of Moos MDQ Phase 1 among athletes & non-athletes**

| **Criteria** | **Athletes (n=50)** | **Non-athletes (n=50)** | **Total (n=100)** | **T value** | **P value** |
|---|---|---|---|---|---|
| **Pain** | 3.32±3.242 | 4.64±4.039 | 4.0±3.7 | -1.521 | 0.128 |

| | | | | | |
|---|---|---|---|---|---|
| Minimum | 0 | 0 | | | |
| Maximum | 11 | 15 | | | |
| **Concentration** | 0.2±0.833 | 2.72±3.27 | 1.5±2.7 | -5.65 | 0 |
| Minimum | 0 | 0 | | | |
| Maximum | 5 | 10 | | | |
| **Behavioural** | 1.42±2.977 | 1.18±1.711 | 1.3±2.4 | -1.37 | 0.171 |
| Minimum | 0 | 0 | | | |
| Maximum | 12 | 6 | | | |
| **Autonomic reactions** | 0.22± 0.465 | 1.12±1.837 | 0.7±1.4 | -2.359 | 0.018* |
| Minimum | 0 | 0 | | | |
| Maximum | 2 | 7 | | | |
| **Water retention** | 0.46±0.676 | 2.6±3.123 | 1.5±2.5 | -3.692 | 0 |
| Minimum | 0 | 0 | | | |
| Maximum | 2 | 10 | | | |
| **Negative Effect** | 1.66±2.327 | 2.16±3.862 | 1.9±3.2 | -0.718 | 0.473 |
| Minimum | 0 | 0 | | | |
| Maximum | 9 | 14 | | | |
| **Arousal** | 0.18± 0.56 | 0.32± 0.978 | 0.3±0.8 | -0.122 | 0.903 |
| Minimum | 0 | 0 | | | |
| Maximum | 3 | 5 | | | |
| **Control** | 0.1±0.364 | 0.32±0.868 | 0.2±0.7 | -1.289 | 0.197 |
| Minimum | 0 | 0 | | | |
| Maximum | 2 | 4 | | | |

*shows significance

The MOOS Phase 1 study aimed to assess the psychological well-being of athletes and non-athletes by examining various criteria. The results indicated that there were several differences between the two groups. Non-athletes reported higher levels of concentration difficulties,

autonomic reactions, and water retention compared to athletes. This suggests that non-athletes may struggle more with maintaining focus, experience stronger physiological responses to stress, and have increased fluid retention or bloating. However, no significant differences were found in pain perception, behavioural changes, negative effect, arousal, and perceived control between athletes and non-athletes. These findings suggest that athletes and non-athletes share similar experiences in these aspects of psychological well-being. Overall, the study provides valuable insights into the differences and similarities in psychological well-being between athletes and non-athletes, highlighting areas that may require attention for non-athletes in terms of concentration, autonomic reactions, and water retention.

**Table 61 : Comparison of the sub-scales of Moos MDQ Phase 2 among athletes & non-athletes**

| **Criteria** | **Athletes (n=50)** | **Non-athletes (n=50)** | **Total (n=100)** | **T value** | **P value** |
|---|---|---|---|---|---|
| **Pain** | 6.86±3.938 | 9.14±4.669 | 8.0±4.4 | -2.964 | 0.003* |
| Minimum | 0 | 0 | | | |
| Maximum | 21 | 19 | | | |
| **Concentration** | 0.48±1.488 | 4.12±4.538 | 2.3±3.8 | -5.736 | 0 |
| Minimum | 0 | 0 | | | |
| Maximum | 6 | 25 | | | |
| **Behavioural** | 2.9±2.88 | 4.78±3.303 | 3.8±3.2 | -2.838 | 0.005* |
| Minimum | 0 | 0 | | | |
| Maximum | 9 | 10 | | | |
| **Autonomic reactions** | 0.48±0.863 | 1.96±2.204 | 1.2+1.8 | -3.919 | 0 |
| Minimum | 0 | 0 | | | |
| Maximum | 3 | 8 | | | |
| **Water retention** | 0.84±1.057 | 2.94±3.146 | 1.9±2.6 | -3.602 | 0 |
| Minimum | 0 | 0 | | | |

| | | | | | |
|---|---|---|---|---|---|
| Maximum | 3 | 11 | | | |
| **Negative Effect** | 1.76±1.975 | 3.94±3.851 | 2.9±3.2 | -3.035 | 0.002* |
| Minimum | 0 | 0 | | | |
| Maximum | 8 | 18 | | | |
| **Arousal** | 0.14±0.405 | 0.18±0.56 | 0.2±0.5 | -0.043 | 0.966 |
| Minimum | 0 | 0 | | | |
| Maximum | 2 | 3 | | | |
| **Control** | 0 | 0 | 0.0±0.0 | 0 | 1 |
| Minimum | 0 | 0 | | | |
| Maximum | 0 | 0 | | | |

*shows significance

The comparison of sub-scales of the Moos MDQ Phase 2 between athletes and non-athletes revealed significant differences in several areas. Non-athletes reported higher levels of pain, concentration difficulties, behavioural changes, autonomic reactions, water retention, and negative effect compared to athletes. These findings suggest that non-athletes experience more physical pain, have greater challenges in maintaining concentration, exhibit more behavioural changes, have stronger physiological responses to stress, retain more water, and experience higher levels of negative emotions compared to athletes. However, no significant differences were found in arousal and perceived control between the two groups. These results highlight the potential psychological and physiological burdens faced by non-athletes and the importance of addressing these aspects for their well-being.

**Table 62: Comparison of the sub-scales of Moos MDQ Phase 3 among athletes & non-athletes**

| **Criteria** | **Athletes (n=50)** | **Non-athletes (n=50)** | **Total (n=100)** | **T value** | **P value** |
|---|---|---|---|---|---|
| **Pain** | 0.24±0.744 | 0.7±1.607 | 0.5±1.3 | -1.622 | 0.105 |
| Minimum | 0 | 0 | | | |
| Maximum | 3 | 8 | | | |
| **Concentration** | 0 | 0.92±2.381 | 0.5±1.7 | -4.325 | 0 |
| Minimum | 0 | 0 | | | |

| | | | | | |
|---|---|---|---|---|---|
| Maximum | 0 | 13 | | | |
| **Behavioural** | 0.14±0.639 | 0.38±1.105 | 0.3±0.9 | -1.083 | 0.279 |
| Minimum | 0 | 0 | | | |
| Maximum | 4 | 4 | | | |
| **Autonomic reactions** | 0 | 0.14± 0.756 | 0.1±0.5 | -1.421 | 0.155 |
| Minimum | 0 | 0 | | | |
| Maximum | 0 | 5 | | | |
| **Water retention** | 0.06±0.24 | 0.32±1.039 | 0.2±0.8 | -1.146 | 0.252 |
| Minimum | 0 | 0 | | | |
| Maximum | 1 | 6 | | | |
| **Negative Effect** | 0.12±0.435 | | 0.4±0.9 | -2.882 | 0.004* |
| Minimum | 0 | 0 | | | |
| Maximum | 2 | 4 | | | |
| **Arousal** | | | 0.4±1.1 | -2.368 | 0.018* |
| Minimum | 0 | 0 | | | |
| Maximum | 3 | 6 | | | |
| **Control** | | | 0 | 0 | 1 |
| Minimum | 0 | 0 | | | |
| Maximum | 0 | 0 | | | |

*shows significance

The comparison of sub-scales in the Moos MDQ Phase 3 between athletes and non-athletes revealed some noteworthy differences. While both groups reported relatively low levels of pain, non-athletes tended to experience slightly higher levels of pain compared to athletes. In terms of concentration, athletes reported significantly better concentration abilities compared to non-athletes, indicating that athletes may have a greater ability to focus and maintain attention. Additionally, athletes exhibited lower levels of behavioural and autonomic reactions compared to non-athletes, suggesting that athletes may have better control over their behavioural responses and experience fewer physical reactions to stress or stimuli. These findings suggest that engagement in sports and physical activity may have positive effects on

pain perception, concentration, and emotional regulation, contributing to the overall well-being of athletes.

**Table 63: Age of menarche**

| Criteria | Athletes (n=50) | Non-athletes (n=50) | Total (n=100) | T value | P value |
|---|---|---|---|---|---|
| Age of menarche | 12.5±1.4 | 12.7±1.3 | 12.6±1.3 | -0.669 | 0.505 |

The comparison of the age of menarche between athletes and non-athletes showed no significant difference. Both groups had a similar average age of menarche, with athletes experiencing menarche at an average age of 12.5 years and non-athletes at 12.7 years. The small difference in age between the two groups is not statistically significant, indicating that participation in sports or athletic activities does not appear to have a significant impact on the timing of menarche. Other factors such as genetics, nutritional status, and overall health may play a more significant role in determining the age of menarche.

**Table 64: Severity of pain**

| Criteria | Athletes (n=50) | Non-athletes (n=50) | Total (n=100) | T value | P value |
|---|---|---|---|---|---|
| Severity of pain | 5.6±2.9 | 6.4±2.4 | 6.0±2.7 | -1.501 | 0.137 |

The comparison of the severity of pain between athletes and non-athletes revealed no significant difference. Both groups reported a similar average severity of pain, with athletes having an average score of 5.6 and non-athletes scoring 6.4 on a scale of 0 to 10. The small difference in pain severity between the two groups is not statistically significant, suggesting that participation in sports or athletic activities does not have a substantial impact on the perceived severity of pain.

**Table 65: Comparison of the Moos Phases between Athletes and non-athletes**

| Criteria | Pre-menstruation vs during menstruation | During menstruation vs post menstruation | Post menstruation vs pre-menstruation |
|---|---|---|---|
| **Pain** | | | |
| Athletes | 0.001 | 0.001 | 0.001* |
| Non-athletes | 0.001 | 0.001 | 0.001* |
| Total | 0.001 | 0.001 | 0.001* |
| **Concentration** | | | |
| Athletes | 0.26 | 0.016 | 0.066 |
| Non-athletes | 0.033 | 0.001 | 0.001* |
| Total | 0.019 | 0.001 | 0.001* |
| **Behavioural** | | | |
| Athletes | 0.007 | 0.001 | 0.006* |
| Non-athletes | 0.001 | 0.001 | 0.008* |
| Total | 0.001 | 0.001 | 0.001* |
| **Autonomic reactions** | | | |
| Athletes | 0.09 | 0.001 | 0.002* |
| Non-athletes | 0.038 | 0.001 | 0.001* |
| Total | 0.008 | 0.001 | 0.001* |
| **Water retention** | | | |
| Athletes | 0.007 | 0.001 | 0.001* |
| Non-athletes | 0.546 | 0.001 | 0.001* |
| Total | 0.1 | 0.001 | 0.001* |
| **Negative Effect** | | | |
| Athletes | 0.777 | 0.001 | 0.001* |
| Non-athletes | 0.003 | 0.001 | 0.01* |
| Total | 0.012 | 0.001 | 0.001* |
| **Arousal** | | | |
| Athletes | 0.773 | 0.926 | 0.864 |
| Non-athletes | 0.393 | 0.033 | 0.149 |
| Total | 0.383 | 0.05 | 0.233 |
| **Control** | | | |

| | | | |
|---|---|---|---|
| Athletes | 0.059 | 1 | 0.059 |
| Non-athletes | 0.011 | 1 | 0.011* |
| Total | 0.002 | 1 | 0.002* |

*shows significance

Table 59 shows the comparisons of the Moos Phases (pre-menstruation, during menstruation, and post menstruation) between athletes and non-athletes across various criteria. The statistical significance of the differences is indicated by the p-values.

**Interpretation of each phase as a comparison between athletes and non-athletes**

**Pre-menstruation vs. During Menstruation:**

**Pain:** Both athletes and non-athletes report a significant increase in pain during menstruation compared to the pre-menstrual phase.

**Concentration**: Non-athletes show a significant decrease in concentration during menstruation compared to the pre-menstrual phase. Athletes, on the other hand, do not exhibit a significant difference.

**Behavioural Symptoms:** Both athletes and non-athletes experience a significant increase in behavioural symptoms during menstruation compared to the pre-menstrual phase.

**Autonomic Reactions**: Both groups show a significant increase in autonomic reactions during menstruation compared to the pre-menstrual phase.

**Water Retention:** Athletes report a significant increase in water retention during menstruation compared to the pre-menstrual phase. Non-athletes, however, do not exhibit a significant difference.

**Negative Effect:** Both athletes and non-athletes experience a significant increase in negative effect during menstruation compared to the pre-menstrual phase.

**Arousal:** There is no significant difference in arousal symptoms between athletes and non-athletes during menstruation and the pre-menstrual phase.

**Control:** Both groups show no significant difference in control symptoms between the pre-menstrual phase and menstruation.

**During Menstruation vs. Post Menstruation:**

The pattern of significant differences in the various criteria observed during this comparison is similar to that of the pre-menstruation vs. during menstruation comparison. Both athletes and

non-athletes experience changes in pain, concentration, behavioural symptoms, autonomic reactions, water retention, and negative effect between these two phases.

**Post Menstruation vs. Pre-Menstruation:**

Pain, concentration, behavioural symptoms, autonomic reactions, water retention, negative effect, and control show significant differences between these two phases for both athletes and non-athletes.

Arousal, however, does not exhibit any significant differences between these two phases for either group.

Overall, the data indicates that both athletes and non-athletes experience significant changes in multiple symptom categories across the different phases of the menstrual cycle. This suggests that hormonal fluctuations during the menstrual cycle can impact various aspects of well-being and symptomatology.

# SUMMARY AND CONCLUSION

# CHAPTER 5

# SUMMARY AND CONCLUSION

The study entitled **"Menstrual Distress among Athletes and Non-athletes – A Comparative Study"** was conducted to study the prevalence of Menstrual distress and its related symptoms and complications among collegiate Athletes and non-athletes from 3 districts of Kerala.

A total of 100 subjects(50 Athletes and non-athletes belonging to the age group of 18–23 years were selected. Sociodemographic data, anthropometric data, biochemical information, dietary information and menstrual distress was assessed using questionnaire and Interview method.

The important findings of the present study are as follows:

- 50 people took part in the study, both athletes and non-athletes. The participants came from a variety of socioeconomic backgrounds, with 10% belonging to the Upper Lower class, 45% to the Lower Middle class, and 45% to the Upper Middle class. According to family structure data, 79% of participants belonged to nuclear families, 19% to joint families, and only 2% to extended families. Families with four people made up the majority (51%), followed by those with five members (22%). 88% of the participants had non-vegetarian eating habits, compared to 2% vegetarians, 6% ovo-vegetarians, and 4% lacto-vegetarians. These results shed light on the individuals' dietary habits, family arrangements, and socioeconomic origins.
- In the study, the BMIs of 50 athletes and 50 non-athletes were compared. According to their BMI, the individuals were divided into four groups: underweight, normal weight, overweight, and obese. Athletes were divided into four weight categories: underweight (32%), normal weight (42%), overweight (8%), and obese (18%). Non-athletes' weight distribution included 14% underweight, 54% normal weight, 16% overweight, and 16% obese. 23% of the whole sample were underweight, 48% were normal weight, 12% were overweight, and 17% were obese when compared to the overall distribution of BMI categories. It is important to note that athletes have a larger percentage of underweight people than non-athletes do.

- The study looked at the incidence of anaemia in 50 athletes and 50 non-athletes. The individuals were divided into anaemic and non-anemic groups. 68% of athletes were not anaemic, compared to 32% of athletes who were. 36% of non-athletes had anaemia, while 64% did not.When the overall prevalence was taken into account, 34% of the entire sample was determined to be anaemic, whereas 66% were not. The statistical analysis, however, shows that there is no appreciable difference in the prevalence of anaemia between athletes and non-athletes. Similar percentages of anaemic and non-anemic people are present in both categories. It should be emphasised that roughly one-third of the study subjects were found to be anaemic.
- The study examined the dietary intake of athletes (n=50) and non-athletes (n=50) and compared several criteria including energy, carbohydrate, protein, fat, calcium, and iron intake.Although the statistics indicated that athletes consumed a little more energy than non-athletes did, the difference was not statistically significant. Between the two groups, there were no appreciable variations in the amounts of protein, calcium, iron, or carbohydrates consumed.However, a noteworthy discovery was that athletes consumed substantially more fat than non-athletes. This shows that athletes may have a distinct dietary strategy and may need to consume more fat to meet their energy requirements or particular dietary needs for their physical activities.

  Overall, while there were some dietary disparities between athletes and non-athletes, most criteria did not find the variations to be statistically significant. The higher fat consumption among athletes draws attention to a possible point of distinction in their dietary habits.
- The HEI of the participant was divided into three categories: low, fair, and good. 36% had a reasonable HEI, 46% had a good HEI, and 18% of athletes had a bad HEI. Comparatively, 44% of non-athletes had fair HEIs, 42% had strong HEIs, and 14% had low HEIs. A statistical analysis revealed no appreciable difference between athletes and non-athletes in the standard of HEI. These results imply that the levels of adherence to a healthy eating index are comparable in athletes and non-athletes. There is space for improvement in both groups' eating habits, while it's crucial to note that a sizable number of them both fell into the fair category.

- On comparing the percentage values of energy and nutrients in athletes (n = 50) and non-athletes (n = 50). The proportions of energy coming from carbohydrate (CHO), protein, and fat were the parameters that were looked at.

  Although the difference was not statistically significant, the results showed that athletes received a little lower percentage of energy from carbohydrates than non-athletes. Between athletes and non-athletes, there were no appreciable differences in the percentage of energy from protein.

  However, a substantial difference between athletes and non-athletes was found in the percentage of energy coming from fat. This shows that athletes' diets may differ from other people's, with a higher percentage of energy coming from fat.
- Non-athletes had a higher NAR(Nutritional Adequacy Ratio) Energy, indicating a better adequacy of energy intake relative to their energy needs compared to athletes. However, there were no significant differences in NAR Protein, NAR Calcium, and NAR Iron, suggesting that both athletes and non-athletes met their requirements for these nutrients. This implies that although non-athletes had a higher energy adequacy, both groups maintained similar levels of adequacy for protein, calcium, and iron.
- The Moos Menstrual Distress Questionnaire Phase 1 study aimed to assess the psychological well-being of athletes and non-athletes by examining various criteria. The results indicated that there were several differences between the two groups. Compared to athletes, non-athletes reported higher levels of focus issues, autonomic responses, and hydration retention. According to this, non-athletes could have more difficulty staying focused, exhibit larger physiological reactions to stress, and experience more fluid retention or bloating. However, there were no discernible differences between athletes and non-athletes in terms of pain perception, behavioural changes, adverse effect, arousal, and perceived control. These results imply that these components of psychological well-being are shared by both athletes and non-athletes. Overall, the study sheds information on areas that may need attention for non-athletes in terms of concentration, autonomic responses, and hydration retention by showing variations and similarities in psychological well-being between athletes and non-athletes.
- The comparison of sub-scales of the Moos MDQ Phase 2 between athletes and non-athletes revealed that, In comparison to players, non-athletes experienced higher levels of pain, attention issues, behavioural changes, autonomic reactions, hydration retention,

and adverse effects. According to these results, non-athletes suffer from more physical discomfort, struggle more with focus, show more behavioural changes, have stronger physiological reactions to stress, retain more water, and feel more negative emotions than athletes. Arousal and perceived control, however, did not show any changes between the two groups that were statistically significant. These findings show that non-athletes may have psychological and physical stressors, and it is crucial to address these issues for their wellbeing.

- While both groups reported very low levels of pain, non-athletes tended to suffer slightly higher levels of pain than athletes, according to the comparison of sub-scales in the Moos MDQ Phase 3 between athletes and non-athletes. Athletes reported much superior concentration skills than non-athletes in comparison, suggesting that athletes may be better able to focus and keep attention. In contrast to non-athletes, athletes also showed lower levels of behavioural and autonomic reactions, which may indicate that athletes have more control over their behavioural responses and are less likely to have physical reactions to stress or stimulation. According to these results, participating in sports and physical activity may improve an athlete's overall well-being by improving their ability to focus, manage their emotions, and perceive pain.
- Multiple patterns can be seen in the data comparing athletes and non-athletes during various menstrual cycle phases. In comparison to the pre-menstrual phase, both groups have more pain, behavioural symptoms, autonomic reactivity, water retention, and adverse effects during menstruation. While athletes do not significantly vary, non-athletes similarly display a decline in focus throughout their period. Arousal and control do not differ considerably for either group between the stages. Similar patterns may be seen in the comparison of pre-menstruation vs. during menstruation as well as the comparison of menstruation and post-menstruation. Significant changes between pre- and post-menstruation are found in both groups' levels of pain, concentration, behavioural symptoms, autonomic responses, water retention, negative effect, and control. There aren't many differences in arousal between these periods.

The study that contrasted Athletes and non-athletes gave useful information about a number of areas of their health and wellbeing. Even though there were some differences between the two groups, several findings lacked statistically significant differences. These are the main conclusions:

economic and social backgrounds The participants represented a variety of family configurations and socioeconomic levels by coming from different socioeconomic backgrounds.

**BMI distribution:** Compared to non-athletes, athletes had a higher percentage of underweight people, indicating that physical exercise may affect body weight.

**Anaemia prevalence:** Around one-third of both athletes and non-athletes were anaemic, highlighting the importance of monitoring both groups' iron levels.

**Food intake:** Compared to non-athletes, athletes ate a little bit more energy and fat, possibly reflecting different dietary approaches or energy needs.

Both athletes and non-athletes consumed enough food to meet their nutritional demands for protein, calcium, and iron, but non-athletes consumed more calories than they required.

**Psychological health:** When compared to athletes, non-athletes showed higher levels of attention problems, autonomic reactions, and hydration retention. Both groups, however, reported having identical experiences with regard to pain perception, behavioural changes, negative effects, arousal, and perceived control.

**Phases of the menstrual cycle:** Compared to the pre-menstrual phase, menstruation was markedly different for both athletes and non-athletes. While certain differences were noted, such as a loss in focus in non-athletes, general parallels were found in pain, behavioural symptoms, autonomic reactivity, water retention, and side effects.

These results imply that physical activity as an athlete may affect body weight, eating habits, and some aspects of psychological well-being. However, additional study is required to better understand the intricate connections between physical activity, diet, and general wellbeing in both athletes and non-athletes. The study lays a platform for further investigation and identifies areas that may need attention, like anaemia prevalence and dietary preferences, to support people's optimum health.

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# APPENDIX

# APPENDIX

## APPENDIX 1

### Questionnaire to assess Menstrual Health

Hi. I am Ashwitha Susan Elias, pursuing Masters in Food Science & Nutrition from St.Teresa's College, Ernakulam. This is a google form for a survey as part of my thesis work. kindly spare some time to fill out the questionnaire. Thanks in advance!

* Indicates required question

1. Name *

2. Email ID *

3. Mobile No *

4. Class of study *

*Mark only one oval.*

- ◯ 1st DC
- ◯ 2nd DC
- ◯ 3rd DC
- ◯ 1st PG
- ◯ 2nd PG

5. Department *

6. Age in years *

7. Type of family *

*Mark only one oval.*

- Nuclear Family
- Joint Family
- Extended Family

8. Number of members in family *

9. Father's Occupation *

*Mark only one oval.*

- Legislators, Senior Officials & Managers
- Professionals
- Technicians and Associate Professionals
- Clerks
- Skilled Workers and Shop & Market Sales Workers
- Skilled Agricultural & Fishery Workers
- Craft & Related Trade Workers
- Plant & Machine Operators and Assembler
- Elementary Occupation
- Unemployed

10. Father's Education *

*Mark only one oval.*

- ◯ Profession or Honours
- ◯ Graduate
- ◯ Intermediate or diploma
- ◯ High school certificate
- ◯ Middle school certificate
- ◯ Primary school certificate
- ◯ illiterate

11. Mother's Occupation *

*Mark only one oval.*

- ◯ Legislators, Senior Officials & Managers
- ◯ Professionals
- ◯ Technicians and Associate Professionals
- ◯ Clerks
- ◯ Skilled Workers and Shop & Market Sales Workers
- ◯ Skilled Agricultural & Fishery Workers
- ◯ Craft & Related Trade Workers
- ◯ Plant & Machine Operators and Assembler
- ◯ Elementary Occupation
- ◯ Unemployed

12. Mother's Education *

*Mark only one oval.*

- ( ) Profession or Honours
- ( ) Graduate
- ( ) Intermediate or diploma
- ( ) High school certificate
- ( ) Middle school certificate
- ( ) Primary school certificate
- ( ) illiterate

13. Monthly family income *

*Mark only one oval.*

- ( ) ≥184,376
- ( ) 92,191-184,370
- ( ) 68,967- 92,185
- ( ) 46,095- 88,961
- ( ) 27,654 - 46,089
- ( ) 9232 – 27648
- ( ) ≤ 9226

14. Diet Pattern *

*Mark only one oval.*

- ( ) Vegetarian
- ( ) Non Vegetarian
- ( ) Lactovegetarian
- ( ) Ovo vegetarian

15. Height (cm) *

16. Weight (kg) *

17. BMI (kg/m2)

18. Hemoglobin level (g/dl) *

19. Have you ever been diagnosed with iron deficiency and/ or anaemia? *

*Mark only one oval.*

- Yes
- No

20. Have you ever used oral iron supplementation or received an iron injection or infusion? *

*Mark only one oval.*

- Yes
- No

21. Have you ever been diagnosed with any of the following? (tick all that apply) *

*Tick all that apply.*

- [ ] Disordered eating
- [ ] Low bone density
- [ ] Asthma
- [ ] Oligo/amenorrhoea (reduced/no periods)
- [ ] Haemochromatosis (iron overload disorder)
- [ ] Depression/Anxiety
- [ ] Hypothyroidism (low thyroid activity)
- [ ] None

22. At what age did you have your first period? *

_____

23. Are your periods regular? *

*Mark only one oval.*

- ◯ Yes
- ◯ No

24. Do you track your own menstrual cycle? *

*Mark only one oval.*

- ◯ Yes
- ◯ No

25. If yes, How do you record your menstrual cycle?

*Mark only one oval.*

- ◯ Smart phone App
- ◯ Electronic diary
- ◯ Paper diary or calendar

26. How useful do you find your method for tracking menstrual cycle? *

*Mark only one oval.*

- ◯ Not useful at all
- ◯ Somewhat useful
- ◯ Moderately useful
- ◯ Extremely Useful

27. What do you use during periods? *

*Mark only one oval.*

- ◯ Sanitary napkins
- ◯ Menstrual cup
- ◯ Tampons
- ◯ Cloth
- ◯ Cotton
- ◯ Other: _____

28. Number of menstrual cycles per year? *

*Mark only one oval.*

- ◯ 0-4
- ◯ 5-8
- ◯ 8-12

29. How many cycles do you miss in a year? *

*Mark only one oval.*

- ◯ None
- ◯ 1
- ◯ 2-4
- ◯ 5-8
- ◯ 8-12

30. How heavy is your flow? *

*Mark only one oval.*

- ◯ Heavy- 5 pads a day
- ◯ Medium- 3 pads a day
- ◯ Light- 2 pads a day
- ◯ Other: _____

31. How long does your period last? *

*Mark only one oval.*

- Spotting only
- 2 Days
- 3 Days
- 5 Days
- More than 5 days

32. In how many days do you get your periods? (i.e. your cycle is how many days)? *

*Mark only one oval.*

- 28 days
- Lesser than 28 days
- More than 28-35 days
- Above 40 days

33. How would you define your menstrual cycle? *

*Mark only one oval.*

- Painful
- Painless
- Sometimes painful

34. Have you ever had surgery for Gynaecological/Women's health related issues? *

*Mark only one oval.*

- Yes
- No

35. Do you use contraceptive pills? *

*Mark only one oval.*

- ◯ Yes, I currently take contraceptive pills
- ◯ No, I never took contraceptive pills
- ◯ I used to take contraceptive pills in past, but have currently stopped

36. On a scale of 1 to 10 (10 being the worst possible pain), how severe is your period's pain? *

*Mark only one oval.*

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. N | ◯ | ◯ | ◯ | ◯ | ◯ | ◯ | ◯ | ◯ | ◯ | ◯ | 10. Worst possible pain |

37. Do you take pain relief medication during your period? *

*Mark only one oval.*

- ◯ Yes
- ◯ No
- ◯ Sometimes

38. Do you crave any particular foods during the menstrual cycle? *

*Mark only one oval.*

- ◯ Yes
- ◯ No

39. If yes, which foods do you crave for?

40. Do you eat any specific foods that are advised during menstrual cycle to boost your energy? If yes, please elaborate.

41. On a scale of 1 to 5, 1 being low and 5 being very high, rate how much you crave for the following foods during your periods (i.e days 1 to 5 of your periods)

*Mark only one oval per row.*

| | 1 (no or low cravings) | 2 | 3 | 4 | 5 (very high cravings) |
|---|---|---|---|---|---|
| **Indian Sweets** | | | | | |
| **Cakes & Cookies** | | | | | |
| **Chips** | | | | | |
| **Fried foods such as samosa** | | | | | |
| **Chaat items such as bhel, pani-puri, etc** | | | | | |
| **Instant noodles** | | | | | |
| **Fruits & Vegetables** | | | | | |
| **Nuts & Dry Fruits** | | | | | |
| **Spicy foods** | | | | | |
| **Fast foods such as burgers, pizza etc.** | | | | | |
| **Egg, meat and fish products** | | | | | |

42. During your period do you regularly (tick all that apply) *

*Tick all that apply.*

- [ ] Pass large blood clots
- [ ] Flood through your protection to clothes or bedding
- [ ] Needing to very frequently change sanitary pads or tampons
- [ ] Needing to wear double sanitary protection
- [ ] None of these

43. Has the doctor ever told you that you might have any of the following conditions (tick all that apply)

*Tick all that apply.*

- [ ] Polycystic ovary syndrome (PCOD)
- [ ] Premature ovarian failure (early menopause)
- [ ] Excess of the hormone prolactin
- [ ] Endometriosis
- [ ] Blocked tubes
- [ ] Irregular ovulation
- [ ] None of the above

44. Do you have any health concerns related to the following? *

*Tick all that apply.*

- [ ] Unwanted hair-growth on your face, abdomen or thighs
- [ ] Milky discharge from your breasts
- [ ] Acne
- [ ] None of the above

# APPENDIX 2

## SCORING OF KUPPUSWAMY'S SOCIOECONOMIC SCALE

### Scoring of Education

The Head of the family is assigned with the scoring for the education, irrespective of whether he/she was the subject or not. Credit for completed degree is only given that is the highest level earned and not the one currently pursuing or not completed.

Secondly, the latest classification includes all persons less than 7 years of age as "illiterate". As per the Census of India, people who are incapable to read and write are treated as illiterate.

**Education of the Head**

| SL No | | Score |
|---|---|---|
| 1. | Profession or Honours | 7 |
| 2. | Graduate | 6 |
| 3. | Intermediate or diploma | 5 |
| 4. | High school certificate | 4 |
| 5. | Middle school certificate | 3 |
| 6. | Primary School certificate | 2 |
| 7. | Illiterate | 1 |

### Scoring of Occupation

The scoring is assigned only for the occupation of the Head of family. In case the Head of family has retired, credit may be given for his/her last job.

When an individual is scored, the categories will move up, that is from unemployed till professional.

**Occupation of the Head of the family**

| SL.No | | Score |
|---|---|---|
| 1. | Legislators, Senior Officials & Managers | 10 |
| 2. | Professionals | 9 |
| 3. | Technicians and Associate professionals | 8 |

| | | |
|---|---|---|
| 4. | Clerks | 7 |
| 5. | Skilled workers and shop & market sales workers | 6 |
| 6. | Skilled agricultural & fishery workers | 5 |
| 7. | Craft & Related trade workers | 4 |
| 8. | Plant & machine operators & assemblers | 3 |
| 9. | Elementary Occupation | 2 |
| 10. | Unemployed | 1 |

**Scoring of Income**

The income scale in the Kuppuswamy SES is revised, "as per changes in the consumer price index (CPI) for industrial workers as projected by the central ministry of statistics and programme implementation on their website"

**Total Monthly Income of the Family**

| **Updated Monthly Family Income in Rupees (2022)** | **Scores** |
|---|---|
| > 1,84,376 | 12 |
| 92,191-1,84,370 | 10 |
| 68,967 - 92,185 | 6 |
| 46,095 - 88,961 | 4 |
| 27,654-46,089 | 3 |
| 9232 - 27648 | 2 |
| <9226 | 1 |

# APPENDIX 3

## CYANMETHEMOGLOBIN METHOD

**Principle:** Blood is diluted in a solution containing potassium cyanide and potassium ferricyanide. The latter converts Hb to methaemoglobin which is converted to cyanmethemoglobin by potassium cyanide. The absorbance of the solution is then measured in a spectrophotometer at a wavelength of 540nm or in a colorimeter using a yellow green filter.

**Equipments required**

- Hb pipette
- Spectrophotometer
- Reagents required : Drabkin's solution pH 7.0-7.4

**Procedure**:

1. Label a series of tubes as follows:

- BLANK
- Lo STD
- Norm STD
- Hi STD
- Norm CONTROL Hi CONTROL Patient (PT)

2. Pipette 5 ml of Cyanmethemoglobin reagent into each tube. Add 20 µl of the appropriate sample into each tube. Do not add anything other than the Cyanmethemoglobin reagent to the reagent BLANK.

3. Allow tubes to stand for 10 minutes.
4. Read Absorbance (A) in the spectrophotometer at 540 nm, zeroing the spectrophotometer with the BLANK solution.
5. Plot Absorbance vs. Haemoglobin Concentration in grams % on linear graph paper.

# ABSTRACT

**Title: "Menstrual Distress among Athletes and Non-athletes – A Comparative Study"**

Abstract: This study aimed to compare the characteristics, dietary intake, nutritional adequacy, and psychological well-being of athletes and non-athletes. A total of 100 participants (50 athletes and 50 non-athletes) from diverse socioeconomic backgrounds were included in the analysis. The findings revealed several noteworthy observations.

Socioeconomic factors showed a distribution of participants across various family structures and income levels. Athletes exhibited a higher proportion of underweight individuals compared to non-athletes, indicating a potential influence of physical activity on body weight. The prevalence of anaemia was similar between the two groups, with approximately one-third of participants being anaemic.

Regarding dietary intake, athletes consumed slightly higher energy and fat, while no significant differences were observed in protein, calcium, and iron consumption. Both athletes and non-athletes demonstrated adequate nutrient intake, although non-athletes had a higher energy adequacy relative to their needs.

Psychological well-being assessment revealed that non-athletes reported higher levels of focus issues, autonomic responses, and hydration retention compared to athletes. However, both groups shared similar experiences in pain perception, behavioural changes, adverse effects, arousal, and perceived control.

Analysis of the menstrual cycle phases indicated significant changes during menstruation compared to the pre-menstrual phase for both athletes and non-athletes. Pain, behavioural symptoms, autonomic reactivity, water retention, and adverse effects were observed to increase, while focus declined for non-athletes.

In conclusion, this study highlights the differences and similarities between athletes and non-athletes in various aspects of health and well-being. While athletes exhibited distinctive characteristics in terms of body weight and dietary habits, both groups shared similar levels of nutritional adequacy and psychological experiences in certain domains. These findings contribute to a better understanding of the impact of physical activity on health outcomes and underscore the importance of addressing anaemia prevalence and dietary choices in promoting overall well-being among individuals. Further research is warranted to explore the complex interplay between physical activity, nutrition, and psychological factors in athletes and non-athletes.